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JOURNAL OF THE ROYAL STATISTICAL SOCIETY

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PART I, 1944.

THE INTERNATIONAL COMPARISON OF INDUSTRIAL OUTPUT

[The Inaugural Address of the PRESIDENT, DR. E. C. SNOW, C.B.E., delivered to the
ROYAL STATISTICAL SOCIETY on March 21st, 1944.]

(1) In presenting the Society with the first inaugural Presidential Address since 1939, I think there is justification for not confining myself to some particular statistical problem, but for including also references to certain other matters likely to be of interest to Fellows. In view of the limitation on our activities in the past four years, I feel that a few comments at this stage on some matters of general concern may be welcomed by statisticians.

(2) It is a source of particular gratification that the Society has been able to make a substantial contribution to the war effort of the United Nations. The Society's library has for a long time been the one place in this country where the statistical publications (and particularly those relating to trade and commerce) of many Governments have been readily available for consultation, and during the war our library has been of great value to a number of our own Government Departments and, even more important, to officers of the exiled Governments temporarily domiciled in London. Great use has been made of the library by representatives of these Governments, and I am told that at times our Reading Room has assumed a cosmopolitan atmosphere reminiscent of international conferences. Fellows will be glad to know of the great value our library has been during the war and of the appreciation expressed by our Allies for the facilities provided for them.

(3) The curtailment of the Society's normal meetings was greatly regretted, but the publication in the *Journal* of papers (with discussions), which in happier times would have been read, provided some consolation for this. In the case of the Industrial and Agricultural Research Section, however, it was found to be impossible either to hold meetings or to publish the Supplement to the *Journal* which would have contained the Proceedings of the Section. The great importance of statistical methods of quality control in many fields during the war created such a demand for discussions that arrangements were made in 1942 for regular meetings of statisticians interested in these problems, under the title "Industrial Applications Group." The attendance at the meetings of this Group surpassed all expectations, and the interest shown in the problems discussed demonstrated the wisdom of arranging the meetings in spite of the many difficulties which had to be faced. The Society, as well as the Group, has reason to be grateful to Dr. Dudding, who took the initiative in this important war development at a most unpromising time. With his colleague, Mr. Jennett, he has carried the main burden of the war-time organisation of the Group, and it is gratifying to know that his labours have borne such excellent results. Some account of the work of the Group has been given from time to time in the *Journal*. The formation of the Industrial and Agricultural Research Section in 1933 was

the chief development of the Society in this century. The Supplement of the *Journal* devoted to the affairs of the Section steadily grew in size, as did the demand from all over the world, and at the outbreak of war it was almost self-supporting. The war has thrown much light on the importance of the type of problems studied by the Section, and I have little doubt that both the Section and the Supplement will steadily expand in size and influence after the war.

(4) The most conspicuous constructive achievement of the Society during the war has been the publication by the Council of a Memorandum on Official Statistics. Statistics must always play a great part in formulating administrative action, but their importance became doubly demonstrated in war-time and in the contemplation of post-war problems. The Sub-Committee which provided the report on which the Council's Memorandum was based was greatly indebted to Mr. Kendall for the very substantial contribution which he furnished, and the great value of the Memorandum at the present time has been generally acclaimed. It is too early yet to say anything about the influence of the Memorandum, but the considerable demand which has been experienced shows the wide interest which is now being taken in the matter. In the re-organization of Government Departments which will be inevitable after the war, it is highly important that the position of statistics and of statisticians should be brought into true perspective, and the Memorandum will, I have no doubt, be of great value to those responsible for the re-organization.¹

(5) The place of statistics in the field of administration provides a *fertile* subject for discussion and for varying views. Administrators themselves are widely diverse in their attitude to statistics and statistics. As in my experience they range from the man who calls at short notice for "any statistics, however rough, which will support a case," to the man who thoroughly appreciates the value of sound statistical foundations and arranges with competent statisticians to survey the field and provide systematic statistics on the subjects likely to come within his scope of action *before* that action is called for. But the statisticians are as variable as the administrators, ranging from those who refrain from providing any material until they are satisfied that it is practically 100 per cent. perfect, however long it may take to reach that state, to those ready to take some risk and provide in a relatively short time some approximation to the required result. In war-time an answer likely to contain, say, 90 per cent. of truth but available in a few hours may be of much greater value than one containing 99 per cent. of truth but not available for days. As in many other matters, the striving for the last few degrees of perfection in statistics may be very costly in time and effort. The supply of a more comprehensive, but not over-detailed information should be considered fundamental for sound administration, and in the ideal world the man or woman responsible for it would be held in high esteem. To those equipped with powers of judgment and ability to weigh evidence, administration depends to a very large extent on the nature and form of the material available for forming a judgment. The statistician should bear to the administrator much the same relation as does the advocate to the judge. In each case the one provides the other with the material for decision or judgment. The status of the statistician should accordingly be of great concern to the administrator. The former

* Since this address was in type, the Prime Minister has announced in the House of Commons that the Society would be invited to discuss the report with representatives of the Departments concerned, and a meeting for this purpose will shortly be held.

should be as valuable to the latter as the skilled advocate is to the High Court judge. War problems have demonstrated the great need for those endowed with the kind of skill enabling them to put before the administrator a clear picture of the problem to be solved.

(6) Administrative problems have multiplied, and with them the demand for competent statisticians. But there is no generally recognized hall-mark of competency in statistics, as there is in most other professions, and the lack of this has been seriously felt in recent years. It was largely for this reason that the Council decided last autumn to appoint a Committee "to consider whether any measures are desirable to improve and to regularize the professional and scientific status of persons engaged partly or wholly in statistical work; and if such measures are found to be desirable, to draft appropriate proposals for carrying them out, including any modifications in the functions or Constitution of the Society which may be considered necessary; and to report on these matters to the Council." That Committee has made substantial progress in its work, and a memorandum is shortly to be presented to the Council.

(7) It may well be that the Society has, in the present period of stress, enough on its hands in the two matters referred to—official statistics and the status of statisticians. But there is a third which, to my mind, is no less important. This is the question of international co-operation between statisticians. On the academic side there is normally a ready means of co-operation between workers in similar fields, and this is reflected in the great development in statistical methodology. The co-operation here is largely through the channels in which the results of research work are published, and which circulate more or less freely among those workers. Though there may not be much automatic personal contact between workers on the same problems in different countries they are nevertheless in touch with one another's work. The Industrial and Agricultural Research Section came into being following informal consultation between statisticians in the United States and those in this country. On the practical side, however, there is little or nothing which automatically brings together statisticians in different countries working in similar fields. Before the war certain official statisticians in different countries met occasionally, but the efforts to produce greater uniformity in official statistics did not appear to make great progress. War-time administrative co-ordination between allies has demonstrated the great need for co-operation between the statisticians who provide the material for administrators, and these are not, even in war-time, all in Government service either here or in the United States. It is not infrequently found, when the administrators meet on the international plane, that terms in general use, and which appear to require no precise definition, are found to have rather different shades of meaning when used in one country from those used in the other. Such terms as "production," "stocks," etc., in general conversation appear to need no precise definition. The statement that the stock of, say, shoes in one country is a and the production b , while in another country they are c and d respectively appears quite straightforward; but when distribution of available materials depends on the figures purporting to state "stocks" and "production" and the microscope is turned on the problem, it transpires that they are capable of diverse interpretation, and it is accordingly necessary to attempt to standardize interpretation—by no means an easy task. For precision purposes the generally accepted definitions are not good enough. I refer later to the differences between the connotations in the United States

and the United Kingdom of the same terms used in connection with censuses of manufacturing output. We should not too readily assume that exactly the same connotation is automatically attached to such terms as "net output per head" when used in different countries. The stage has now been reached when it is important that such terms should be subject to scrutiny in order to ascertain if they have exactly the same context, or if adjustments are needed in the interpretations attached to them in one country or another. International co-operation will always be on a precarious basis unless the participants understand exactly what every word and term used by the other really means. Others have probably had experience similar to mine. I have been present at international proceedings at which acrimonious discussions have developed on issues which looked apparently quite simple. When they were ultimately resolved, they were discovered to be founded on differences of understanding of the precise meaning of the terms used.*

(8) International conferences and discussions are likely to occupy much more of our attention in the future than in the past, and if these are to create more unison and not be productive of misunderstandings, it is essential that the terms used should be precisely defined. The importance of carrying on such discussions with a clear understanding regarding fundamental facts cannot be over-stressed. It seems to me, therefore, to be desirable to bring into being some international organization which can convene conferences, if necessary at short notice, in order to discuss the purely statistical aspects of problems which will have to be faced after the war. It is not sufficient to wait until the problems present themselves for urgent solution. Everyone with insight into the nature of the problems can foresee the great advantages which will ensue if there is a good measure of agreement in advance as to the factual basis of the questions which will have to be faced in due course. In the international sphere, as in the individual business, it should be somebody's job to foresee the data likely to be needed in the future for the intelligent handling of the problems likely to arise, and not to wait until they become matters of urgency. In national affairs this Society has tried from time to time to provide some foresight. (It is pertinent to point out that the failure on the part of the Government to take the advice of the Society stressing the great value of a quinquennial census of population in 1936, cost the nation dearly in the consideration of the problems which faced us in 1939. Until the national registration was undertaken in 1939 information regarding our population was more than eight years out of date, and that at a period when striking changes were occurring in age distribution. The proposal was rejected on grounds of national economy. It is unfortunately impossible to calculate what has been the national cost of this false economy.) Some organization to perform in the international sphere some of the functions which this Society tries to carry out on the national plane now seems called for. I would plead for a permanent international organization of statisticians, based upon the national statistical societies where they exist, but with scope for including individual statisticians of

* I can make the point clearer perhaps by an example. For centuries I believe there has been no misunderstanding caused, even on the international plane, by the use of the word "hide" applied to the skin covering the body of cattle. But when it became a matter of division of supplies between the United Nations, the discussions on the subject disclosed that for precise statistical purposes, one country had different notions from another as to exactly what was intended. More precision has now to be introduced into such definitions.

countries—likely for some time to be the majority—where such societies do not exist. Having been responsible in another sphere for bringing such an international organization into being, I am fully aware of the difficulties to be overcome, but the results which may be achieved are likely to be very substantial. I am sure that there is no statistician in any country who would not benefit by regular contacts with those working on similar problems in other countries.

(9) I do not forget, of course, that there was in being before the war the International Statistical Institute. This organization was formed about 60 years ago and survived the last war without great difficulty. It is impossible to say at the moment if it will survive the present war. (The only office-bearer in this country—Lord Stamp—has been one of the war's most prominent victims. He was honorary Treasurer, and would, I understand, have been the next President. A short report was provided in the *Journal* (CII, 1939, p. 83) of the last meeting, held in Prague in September 1938. No statistical problems were apparently discussed, the topic which absorbed universal attention among those present being how to get away from Prague). Even if it does survive this war, it is most unlikely to be able to function again in time to be of assistance on some of the urgent post-war problems. I consider that, even if it is in a position to function quickly after the war, its composition and constitution are such that it is most unlikely to be able to make any useful contribution to those urgent problems. It might, after certain reforms, be made a practical organization for international discussion of statistical problems when the urgent ones have been cleared out of the way and we can settle down to the more deliberate methods of debate which existed before 1939.

(10) My view is that a new organization should be formed, not necessarily to supplant the International Statistical Institute, but to approach international statistical problems in a more realistic manner. The subject of statistics for a long time to come is likely to be quite big enough to justify the existence of two organizations of international scope. The one I contemplate would be on a broad basis, and would try to enlist the interest of all statisticians, and particularly of those relatively young. The International Statistical Institute is predominantly a Society of those of long standing, and there is no reason, if its members wish, why it should not resume its deliberations as in the past. Quite a substantial proportion of its investigations have related to demographic statistics—a section of statistical science far in advance of some of the others and in which international co-operation has been prominent for a long time. In other fields, however, it has lagged far behind, and it is just those fields in which at the present time action seems to be most needed. The agenda for an international statistical conference, if such could be arranged in the near future, should include consideration of the methods of calculating national income, since this has now become a matter of practical importance as a result of the recent decision of the United Nations Relief and Rehabilitation Administration conference at Atlantic City to assess nations on the basis of estimates of their national income.

(11) I now come to the statistical problem, which I propose to consider under the title "The International Comparison of Industrial Output," drawing illustrations from the leather and footwear industries, the only ones of which I have any detailed knowledge. The importance of the subject at the present time is clear. The turn-over from war to peace activities will involve a good deal of re-organization of industry in this country, and in others almost com-

plete rebuilding. In this process the need for means of comparing output in one country with that in another will arise. In some quarters it is considered that industry in this country is lagging behind that in the United States and recently data of a general character from the censuses of industrial production of this country and the United States have been used for the purpose of comparison. Following the publication in the *Economic Journal* in April of last year of an article on "Industrial Production; Productivity and Distribution in Great Britain, Germany and the United States" by Dr. Rostas, of the International Institute of Economic and Social Research, *The Times* published two articles by Sir George Schuster entitled "Industry after the War," and there has been subsequent correspondence in the columns of that newspaper. Taking as his text the sentence in a broadcast by the Prime Minister that "it is our duty to peer through the mists of the future to the end of the war and to be prepared by ceaseless effort and forethought for the kind of situations which are likely to occur," Sir George surveyed the outlook for British industries, and expressed the view that "there are impressive prima facie grounds for the view that Britain in important fields has dropped so far back in the order of efficiency among industrial countries that we dare not be content to face post-war conditions with pre-war standards. A programme may be required involving scrapping and replacement of plant on a very large scale." Sir George's view was based to some extent on certain index figures contained in the article in the *Economic Journal*, though he made it quite clear that he had other evidence on the subject. Indices, however, are notorious as sources of fallacy, and an examination of those purporting to relate to the international comparison of industrial output seems very desirable. Dr. Rostas in his article expressed more than one warning of the possible fallacies involved in the comparison of indices, and in a footnote stated: "It is obvious therefore that much arbitrariness was involved in these calculations in almost every single case and some of the indices are highly conjectural." Footnotes are apt to receive less attention, however, than tabular statements, and quotations from tables, without quoting at the same time the footnotes showing the restrictions to be placed on the interpretation of the figures, may be the source of much misunderstanding. I have seen quotations from the table in Dr. Rostas's article showing "Physical output per head in certain manufacturing industries" to the effect that (1) the output per employee in the boot and shoe industry in the United States is 65 per cent. more than in the United Kingdom, and (2) the output per employee in the motor-car industry is 319 per cent. higher in the United States than in the United Kingdom. In neither case was the caution added that "the indices are highly conjectural." It is all to the good that conjectures should be thrown out for criticism and discussion. Progress towards truth is frequently made through discussions on hypotheses which may ultimately be overthrown; but in most branches of science discussion is generally confined to those primarily working on the problems involved and with special knowledge of them. The results of the work are frequently of interest to the general public, but they do not reach the wider sphere until the conjecture has been thoroughly investigated from every angle and its truth largely substantiated. It is one of the drawbacks of this type of statistical investigation that the investigator cannot put forth hypotheses for consideration by others without running the risk of his conjectural statements being prematurely quoted outside the specialized circle. The only safeguard I can suggest to avoid this drawback

and to permit statisticians to conduct their controversies in some degree of privacy, is that memoranda containing such conjectures should be prominently marked with a warning somewhat as follows: "No figures or statements from this paper should be quoted without quoting at the same time the following note." Then should follow a sentence similar to that used by Dr. Rostas. If this were done, no responsibility could reasonably be attributed to the original author for any harm done by premature discussion outside the circle of specialists.

Index of physical output per head

(12) It is in the spirit of a fellow-worker helping to get to the truth that I put forward some observations on the table in Dr. Rostas's paper which appears to have attracted most public attention: "TABLE V—Physical output per head in certain manufacturing industries." In each case the United Kingdom figure for 1935 is taken as 100 and that for the United States for 1937 set out alongside. A few of the indices (including the highest and lowest) are:—

Motor-cars	...	...	...	...	...	...	419
Radio sets	...	...	...	...	...	...	482
Cotton-spinning	...	...	...	...	...	...	120
Boots and shoes	...	...	...	...	...	...	165
Mainly capital goods industries and mining (unweighted average)	...	...	...	...	...	...	240
Mainly consumption goods industries (unweighted average)	...	...	...	...	...	...	184
All trades covered by sample (unweighted average)	...	...	...	...	...	...	206

(Dr. Rostas has also included figures for Germany throughout his Memorandum, but as I have not been able to examine the volume containing the results of the German census, I confine my remarks to the comparison of the United Kingdom and the United States figures).

Importance of periods used for comparison

(13) The first observation to make on the table is that the use of data for the two countries referring to periods separated by an interval of as much as two years may in itself be a source of appreciable error.* The desire to use the latest data available is understandable, and it is unfortunate that no census has been taken in this country since that of 1935. As the results of a census taken in the United States in 1935 have been published, an additional column might well have been added to the table so as to provide comparable data with that of our census for 1935. 1937 was a more active year industrially than 1935 in both the United States and the United Kingdom. An index of the United Kingdom industrial production for 1935 was 105.6 and for 1937 123.6. Corresponding figures for the United States were 75.6 and 92.2. We should expect physical output per head to be higher in the more active of the two years, since the working time per head is usually greater in periods of activity. The United States reports provide indices of (a) quantity of production and (b) production per wage earner for each census year. The figures for (a) for 1935 and 1937 were 227 and 303 respectively (1899 = 100), while for (b) they were 145 and 156. The comparison of data for the different years,

* It is shown later (paragraph (27)) that the interval may, in fact, be more than 2 years.

therefore, is likely in general to show the United Kingdom in a more unfavourable light than would otherwise be the case.

Conversion of different types into one product

(14) The second observation to make on the comparison of the indices of physical output per head is that the output of a particular article—e.g., footwear or motor-cars—is made up of the output of different types—e.g., men's footwear, women's, girls', etc. For the purpose of obtaining the indices, the figures of the output of these different types should be weighted by factors representing the amount of physical effort involved in making them. (The great difference in this respect between an 8-h.p. car and one of 40 h.p. will be apparent.) Accordingly it is necessary to convert output "into one homogeneous product," and some system of weighting the output of each type must be adopted. Dr. Rostas's method of doing this was "on the basis of relative values"—that is to say, the output of each type was multiplied by the average gross value of that type. In the case of footwear output, for example, for the United Kingdom in 1935, the relative gross values of (a) men's, (b) women's, (c) boys' and youths', (d) girls' and maids' and (e) all others were in the proportions 100, 85, 52, 38, 20 respectively. (For the United States 1935 the corresponding figures were 100, 88, 70, 50, 41.) These factors were then applied to the corresponding figures of output, and the number of "equivalent men's footwear" determined. But the proper factor to use for this weighting, if it were available, would clearly be some measure of the labour involved (e.g., wages) in making each of the respective types. The U.S. report indicates that wages over the whole of the footwear industry accounted for only about 25 per cent. of the gross value. It is clearly inaccurate to weight by a factor only one-quarter of which is represented by labour (and this percentage would be different for each type) and the bulk of the rest depends on materials which vary over a very wide range.*

Determination of number of workpeople associated with particular physical output

(15) The next consideration to refer to affecting the comparability of indices of "physical output per head" is the difficulty of ascertaining the correct number of "heads" applicable to the actual quantity of output. In the United Kingdom the total number of persons employed in the footwear manufacturing industry for a grand total value of gross output of the industry in 1935 of £40,180,000 was 116,567, of whom 108,649 were operatives. But the value of the finished footwear produced in the whole country, including finished footwear to the value of £48,000 produced outside the "industry," was only £37,619,000, and it was the physical output represented therefore by

* The unsuitability of "relative values" as weighting factors in this problem can be generally demonstrated.

If n_r = production of articles of r th type
 v_r = total value of articles of r th type

Then weighted production (as number of type 1 equivalents) is equal to $\sum n_r \cdot \frac{v_r}{n_1} \cdot \frac{n_1}{v_1} = \frac{\sum v_r}{v_1/n_1}$, which is clearly equal to the gross value of all types divided by the average value of the reference type. Different results will be obtained by taking different types for reference, but the values of the non-reference types exercise a dominant influence on the results.

£37,571,000 on which the index of physical output per head was based. Other products valued at £2,609,000 were produced by these 108,649 operatives in addition to the finished footwear. Accordingly, in determining the fraction representing the physical output of footwear per head for the United Kingdom the denominator 108,649 appears to be overstated by about 7 per cent., since this is the percentage of value of products other than finished footwear turned out by those operatives. In the United States in 1935 the total value of the actual footwear was \$641,464,000, out of \$643,872,000 for the grand total output of all products of the industry, leaving less than $\frac{1}{2}$ per cent. to be accounted for by the other products. The application of the number employed in the industry as a whole to the quantity of finished footwear produced in the "industry," accordingly, produces another bias against the United Kingdom in the comparison. If the United Kingdom industry were as compact as that of the United States (having 99.5 per cent. of its total output by value in the form of finished footwear), the figure for physical output per head would appear rather less unfavourable. To what extent this consideration applies to other industries I have not enquired, but it may well be considerable in some cases. Another consideration bearing upon this aspect of the problem is the effect of short-time working. If one nation practises short-time working to a substantial extent, while the other nation discharges some operatives but keeps the remainder on at full time, the comparison of output per head is obviously faulty. In the footwear manufacturing industry of the United Kingdom it is possible to provide some indication of the extent of short-time working from monthly statements published by the *Ministry of Labour Gazette* and based upon a substantial sample of the industry (about 50 per cent.). Each month the percentages of operatives working short time and the average number of hours short were stated. Similarly, the percentages of operatives working overtime and the average number of hours overtime worked were given. Taking the mean of the figures for the twelve separate months of 1935, 27½ per cent. of the operatives were working short time to the extent of 8½ hours weekly on the average. As against this 14 per cent. of the operatives were working overtime to the average extent of 4 hours weekly. I know of no similar information available for the U.S. industry, but I understand that short-time working is much less prevalent than in this country. If, instead of working short time, the equivalent number of operatives in this country had been discharged, the number of employees returned in the U.K. industry would have been reduced by more than 5,000 and the "output per operative" increased by nearly 5 per cent. It will be clear from this example that no satisfactory comparison of productivity of labour in the two countries can be obtained in the absence of information regarding the short time worked.

Difficulty of industrial grouping

(16) A further point indicating lack of comparability in measuring physical output per head arises from the fact that firms not within the industry have some production of the chief products of the industry. The employees in these firms are counted with the industry of their main products, but some of the products (of minor importance to the firms concerned) may be counted in the output of another industry. In 1935 for the United Kingdom the table providing particulars of "output of principal products" for the boot and shoe

industry included output recorded by firms whose returns were made on schedules for other trades. The total value in this case, however, was not large, amounting to £408,000 and including 500,000 pairs of footwear. The employees making these 500,000 pairs were excluded from the number employed in the footwear manufacturing industry. In the case of the United States, for 1935 establishments engaged primarily in other lines of manufacture reported the production of products belonging to the boot and shoe industry amounting to \$209,000—a figure much less than that for this country. Again, therefore, this factor affecting comparability of the index “physical output per head” produces an apparent bias against the United Kingdom. It is not of much importance in the case of the industry which I happen to be able to use for illustration, but it may possibly be much higher in less well-defined industries. An essential feature for proper comparability of “physical output per head” for a certain article in two countries is that the figures of operatives should relate exactly to the production of the article, and to nothing else. I do not intend to attempt any detailed examination of the other indices of physical output per head, as that can be far better done by those having actual knowledge of the circumstances of the industries. I suggest, however, that a partial explanation of the very unfavourable showing of the United Kingdom in motor-car production per head is due to this difficulty of the proper determination of the number of “heads.” This matter is referred to later in paragraph (28).

Physical output per head for areas in same country

(17) It occurred to me that it would be of interest, in trying to assess the value to be attached to the comparison of the indices of relative physical output per head for a particular industry in the two countries, to attempt by the same method to determine the relative physical output per head for a particular industry for different areas in the same country. In the case of the footwear industry in this country detailed production figures have been published for the chief areas of manufacture. There are, however, substantial difficulties in the way of using these figures for the purpose, owing to the fact that the figures of employees in the industry in those particular areas were not given. Figures of employees were given for certain regions into which the country was divided in the report for general purposes, without regard to the situation of individual industries, but as the areas for footwear production do not correspond to the regions, it was impossible to make use of these employment figures. There appeared, however, to be an alternative. The census of population reports are in such detail that for each of the footwear production areas it was possible to determine the number of individuals who returned their occupation at the census of 1931 as connected with footwear manufacture. On further examination, however, it was found that where comparisons appeared possible, the differences between the figures in the census of population and those returned as employed in the industry in the census of production report were too great to justify the use of the former as substitutes for the latter. The results of proceeding on these lines would have been so extremely “highly conjectural” that I satisfied myself they should never be printed. The importance of trying to ascertain some means of assessing the value of the international comparison, however, seems sufficiently great to justify the use of some statistics collected

during the war for the purpose. These were on the lines of those published in the Report of the 1935 census, and provided figures for the output of different classes of footwear in separate areas, but also provided the number of operatives employed in those same areas. The value of the footwear, however (needed for the purpose on converting the different types into one homogeneous product by the method referred to above), was not ascertained, so that it was not possible exactly to adopt the previous method. The *relative* values of men's, women's, boys', girls' and infants' footwear, however, do not change much from year to year, and no appreciable error will arise by applying the relative values, determined in 1935, to later output.* The production figures of (1) men's, (2) women's, (3) boys' and youths', (4) girls' and maids' and (5) infants' for the period were used. These were converted into equivalent "women's" on the basis of the following "relative values" furnished by the 1935 census : (1) 118; (2) 100; (3) 61; (4) 50; (5) 26. The figures of "equivalent women's output" were divided by the number of operatives employed in each of the six areas for which figures were available, and led to the following figures for the six areas of "equivalent women's pairage per operative per month": (a) 89; (b) 97; (c) 102; (d) 124; (e) 127; (f) 149. These figures give the following indices of "physical output of footwear per head" in the six areas: (a) 100; (b) 109; (c) 115; (d) 139; (e) 143; (f) 167. Thus there appears to be one boot-manufacturing area in this country in which the "physical output per head" if the method is appropriate—appears to be 67 per cent. above that of another or about the same as is indicated for the U.S. industry as a whole above that of the U.K. industry as a whole. It is impossible for anybody with detailed knowledge of the industry to accept this result as having any realistic meaning. Practically all manufacturers use plant provided by one firm on a rental system, and that firm has substantial interest seeing that all manufacturers are up to date in equipment. Labour and wage conditions are regulated as a result of joint arrangements between Unions and employers' organizations covering the whole country, and are accordingly fairly uniform. Capacity for production is far in excess of normal demand, and in peace-time competition between manufacturers is very keen. I am sure that if those with wide knowledge of the industry were asked for an explanation of the figures set out above, the answer would be that they were due to the peculiarities of statistics rather than to factors within the industry. I have already indicated what I deem to be the source of the fallacy. It lies in the assumption that for the purpose of measuring physical output the various types of footwear can be weighted "on the basis of their relative values"—*i.e.*, that the output in pairs of operatives making men's footwear can be considered as 18 per cent. more than the output of those making women's and 136 per cent. more than those making girls' boots or shoes.

Need for specialist knowledge of industries investigated

(18) It would be very useful if the indices of output provided by Dr. Rostas for different articles could be examined in detail by those having detailed knowledge of the industries concerned. I have indicated and illustrated a few of the criticisms which appear relevant. It is unlikely that proper deductions can

* An argument similar to that of the footnote in paragraph (14) can also be developed for this procedure.

be made from the comparisons of the two censuses by general considerations alone, since there is much difference in the circumstances of different industries. I think it unlikely that any general basis applicable to all industries can be appropriate for converting "different types of the same commodity into one homogeneous product." The relationship between (a) the result of physical effort on output and (b) the gross value of the article produced must, of course, vary widely, in view of the widely different proportions which the item "materials" bears to the gross output (80 per cent. in the case of grain milling and 37 per cent. in the case of iron and steel foundries are two instances taken almost at random from the Final Report of the 1935 Census). It would lead far beyond the intentions of this Address to attempt any general formula for improving on Dr. Rostas's method of "converting different types into one homogeneous product." In due course, no doubt, statisticians specialist in individual industries will be in a position to throw light on the subject, and until they do I doubt whether it is profitable to spend much time on discussing the problem in general terms. Industries do not fit into a standard pattern. The one I know most about uses material of relatively high value with relatively few operatives. (The value of the material per operative in the leather industry in 1935 was £600.) Notions formed from association with such an industry might lead me quite astray in considering the cases of an industry where materials used are relatively small but operatives relatively many (e.g., mechanical engineering, where the value of material per operative in 1935 was only £157). Generalization about industry seems particularly prone to lead to fallacy.

Interpretation of census of production results

(19) In view of the likelihood that the reports of the Censuses of Production of the United Kingdom and the United States will be more extensively used in future for the purpose of drawing comparisons between the industries in the two countries, a detailed examination of the fundamental bases of the two censuses appears to be called for. Those uninitiated into the mysteries of production statistics who consult the reports for the purpose of obtaining facts comparing industry in the two countries in the same way as they might to compare populations should be warned of the complex basis of the statistics involved. There is little or no scope for fallacy in comparing statistics of population of two countries. In each country a large number of householders have made simple statements concerning those living in the household, and these have been aggregated. Apart from accidental or deliberate mis-statements by the householder, the published figures can be accepted without requiring any particular warning regarding their interpretation. The statement that the population of the United States was 133,000,000 and the population of England and Wales was 41,000,000 can be accepted as indicating definitely that, assuming no errors were made in filling up the schedules, there were 3·244 times as many people in the United States as in the United Kingdom; but the statement that the gross value of the output of factory industry in the United States was £9,182,000,000 and in the United Kingdom it was £2,837,000,000 (the figures provided by Dr. Rostas) does not mean that, making the same assumption that the schedules were correctly filled in, the industrial output in the former country was 3·236 times that in the latter, as it might appear to be before the complexities of the term "gross value of output" are

understood. There are a number of difficult points involved in the interpretation of census of production results, and these should be understood before comparisons are attempted of the results for two different countries. I will attempt to describe the most important of these in some detail. Before doing this, however, a brief historical note of the two censuses may be of interest.

History of censuses of production

(20) Regular nation-wide records of manufacturing output have been kept in the United States since as long ago as 1849—decennially for 50 years, then quinquennially for 20 years and since 1919 biennially. In this country the first census was not taken until 1907, and an Order was made providing that further censuses should be taken at intervals of five years. The report of that taken in 1912 was never published, and the one that fell due in 1917 was not taken. Subsequently an amending Act provided that a census might be taken in any year fixed by an Order made by the Board of Trade and laid before Parliament. Under this a third census was taken in respect of 1924 and a fourth in respect of 1930. The passing of the Import Duties Act in 1932 furnished the Board of Trade with additional powers to require statistical returns regarding establishments engaged in the manufacture of goods which would be chargeable with Customs duties under that Act, and these powers were further extended in the Finance Act of 1933. Enquiries under the Act were made in respect of the production of both 1933 and 1934. The restricted nature of these enquiries is indicated by the fact that they cover only about two-thirds of the total output of factory industries for 1935. However, in 1935 the Board of Trade exercised their powers under both Acts, and the investigation covered the whole field permitted by the Census of Production Act; additional enquiries were also addressed to firms affected by the Import Duties Act. The 1935 enquiry accordingly was more comprehensive than any previous one. The passing of the Act in 1906, giving the Board of Trade powers to take the Census, was not without criticism from certain Members of Parliament. Lord Robert Cecil complained that it conferred too great power on the Board to take any action it liked regarding industry. The Bill, he said, might have been compressed into three lines: "The Board of Trade shall take a Census and shall do exactly as it likes in taking that Census." This view of the Board's powers is not confirmed by the very tolerant administration of successive censuses. On the subject of the frequency of censuses, it is of interest to note that Mr. Lloyd George, President of the Board of Trade, who was responsible for the Bill, stated that while he was not hopeful of having an annual return for the first few years, he hoped it would be possible to make it more frequent than every five years. Two wars, plus the alternation of booms and slumps between wars, have demonstrated the great importance of regular systematic information concerning industrial output, and it is greatly to be hoped that the Board of Trade censuses will be resumed as soon as practicable. The great advantage of having data available for direct comparison between the manufacturing position in this country and the United States points at once to the need for us to adopt the time-table of that country, or by agreement, to have some other uniform plan. It is too much to hope that other nations can straight away fall in with the same time-table, but if the two countries who have moved so far in international co-operation during the war can agree to

work in step statistically afterwards (a very small measure compared with the great strides in co-operation during the war), an example will be set for other nations to adopt the same time schedule as soon as they may find it practicable. The example to other countries would be the more marked if the British Dominions could also come into the common programme.

Methods of determining value of production

(21) It is not easy to determine the best order in which to deal with the various points which arise in the comparison of the basic factors in the censuses of the two countries, as some of these are involved with others. A summary of the points dealt with is provided in paragraph (32), and prior reference to that paragraph may assist in the reading of those preceding it. Perhaps the most fundamental is that of the method of determining the values of the production involved, and I will discuss that first.

The instruction given to manufacturers in the United Kingdom regarding values was in the following terms :—

“ The values to be shown are the net selling values of all deliveries of goods within the year of return plus the book value of stocks at the end and less that of stocks at the beginning of the year.”

In determining the net selling value, firms were instructed to deduct from the amount charged to customers for such items as discount, payments to transport firms, railways, etc., for carriage outward and allowances for returnable cases, etc. The corresponding instruction to manufacturers in the U.S. was as follows :—

“ The selling values f.o.b. factory of all products manufactured during the census year whether sold or in stock. It covers selling expenses except for those establishments which maintain separate sales departments, in which case the values at which the production is turned over to the sales department are reported.”

The difference between the two methods may be appreciable. A firm using the British formula to value its output would not necessarily reach the same result by the use of the American formula. If the formulae were rewritten in order to deal with quantities rather than values, provided the articles produced and sold were expressed in terms of one quantitative unit, the result would be the same. But the book value of stocks is not necessarily the f.o.b. factory price of articles sold, nor is the price at which stocks at the beginning of the period are valued necessarily the same as the price used for valuing stocks at the end. For an industry in which the terminal stocks by quantity are large compared with the quantity manufactured or sold in an accounting period—e.g., the leather industry—and in which there are wide fluctuations in prices, the value of the product by one formula would certainly be different from its value by the other. It is quite impossible to make any calculations of the extent of the difference or to form an opinion whether in 1935 it overstated the U.K. or the U.S. production relative to the other. If it were the practice in one country to hold bigger stocks relative to turnover than in the other, the value of the output by the British formula would be under-stated relative to

that by the U.S. formula, since stocks are generally valued at lower than f.o.b. factory prices. This is a point which is not likely to be readily discernible by those wanting to make general comparisons of the output of the two countries, and although we cannot say what the effect of the difference is, it is important to put on record that there is a difference in the methods of calculation of the value of output in the two countries.

Effect of duplication

(22) There is a further reason why the comparison of the value of gross output of industry for two countries is almost certain to be misleading. "Gross output" is merely the aggregate of the values of the output of all the individual firms, and unless the structure of industry in the two countries is identical, the comparison is affected. Gross output is not the aggregate value of all the finished articles produced. It is affected by a certain duplication, and although the importance of this duplication is appreciated by students of the subject, it may be well to illustrate the point by a simple example. Assume that the process of converting the original raw material into the final product for the market consists of two parts—(a) converting that raw material into an intermediate product (e.g., ore into matte, or wool into tops) involving an addition of 30 per cent. to the value of the raw material, and (b) the conversion of the intermediate product into finished products, involving the addition of a further 50 per cent. If there were only one firm in the industry, £100 of raw material would become £195 of finished product (passing through the intermediate stage at £130, but not being sold as such); but if the industry consisted of two firms, the second buying the intermediate product from the first for £130, to which it added 50 per cent., the gross output of the industry consisting of the two firms would be £325. The value of the finished products available for sale by the industry would still be only £195, but the duplication created by one firm using as its raw material the finished product of the other raises the aggregate output of the two firms to £325. This sort of duplication exists in both U.K. and U.S. industries. If it is present relatively more in one case than in the other, comparison of the gross output will not lead to the same ratio as comparison of the value of the finished goods produces. The proper comparison for measuring the importance of two industries is that of the value of the finished products produced for use, either for consumption or for plant. The gross output figure in each case should therefore be reduced by the amount of duplication. It is, however, a big task to determine the amount of this duplication.* In the report of the U.K. census for 1930 an estimate was given that the value of industrial products manufactured was £2,286,000,000 $\pm$ 19,000,000 or 67 per cent. of the gross output of £3,406,000,000. For the United States an estimate made from the data of 1929 indicated that the value of the products was approximately also two-thirds of the gross output.

The extent of duplication varies for different industries. The U.K. report for 1930 showed that for the cotton industry there was duplication to the extent of £50,000,000 in the total gross value of output of £158,000,000. The only comprehensive statement of the extent of variation in different industries I have seen is that provided by the U.S. report for 1929.

* See "Relative Importance of Export Trade," *Journal of the Royal Statistical Society*, 1931; also Final Report of Census of Production for 1930.

For that year for sixteen industrial groupings the gross output and the percentage of duplication included in it were as follows:—

	Gross output million \$.	Percentage of duplication
(1) Food and kindred products	12,023	19·4
(2) Textiles and their products	9,243	36·6
(3) Forest products	3,591	35·0
(4) Paper and allied products	1,892	36·8
(5) Printing, publishing and allied industries	3,170	23·9
(6) Chemical and allied products	3,759	28·3
(7) Products of petroleum and coal	3,648	9·8
(8) Rubber products	1,117	31·2
(9) Leather and its manufactures	1,905	40·6
(10) Stone, clay and glass products	1,561	10·8
(11) Iron and steel and their products, not including machinery	7,137	41·1
(12) Non-ferrous metals and their products	3,597	44·4
(13) Machinery, not including transport equipment	7,043	36·3
(14) Transportation equipment, air, land and water	6,047	60·2
(15) Railway repair shops	1,270	41·1
(16) Miscellaneous industries	3,426	22·6
All industries	70,435	32·9

The extent of duplication is far greater in the industries manufacturing vehicles than in any other, reflecting, of course, the fact that these industries are largely "assembling industries," purchasing many of the articles used in a form ready for use. There is more scope for difference in the proportion of duplication between the two countries in those industries for which the amount of duplication, by reason of the nature of the work, is large. This consideration has special bearing on the comparison of the output of the motor industries in the two countries.

Appropriate rate of exchange for comparison of values

(23) Perhaps of even more importance in the comparison of the output of the two countries for 1935 than the question of the method of valuation of the articles produced is that of the appropriate exchange factor for comparing the values of production in the two countries when one is measured in sterling and the other in dollars. Dr. Rostas used the average value of the year (\$4.90 to the £ for 1935) of the market quotations. The ground for this seems to be that it is the only figure comparing these currencies which is readily available. It may well be, however, inappropriate for the purpose in hand. Perhaps after a period of twenty years or so in which currencies have been stable with fluctuations never outside the old-fashioned "gold points," it might be reasonable to assume that the market rate was appropriate for comparing the values of the industrial output of the two countries, even if there was no movement of the product of the industry from one country to the other. The currency history of the few years before 1935 had been marked by wide fluctuations. The average market value of the dollar-sterling exchange for the few years before 1935 had been:—

1935	4.90
1934	5.04
1933	4.22
1932	3.50
1931	3.69
1930	4.86

It seems unwarranted to assume that after such a stormy period in international exchanges, the currency circumstances applicable to individual industries would be quickly assimilated to the average market rate.

The attempt to find a value for the exchange rate suitable for general application to the comparison of the output of industry as a whole in the two countries is not likely to meet with much success. At first sight it might appear that some light would be thrown upon the problem by comparison of the external trade returns of the two countries. Articles exported from one country are valued in the trade returns of that country in one currency. When these articles are imported into another country, they are valued in the currency of that other country. By making allowances for the difference involved through the fact that exports are valued f.o.b. while the corresponding imports are c.i.f., the average price in one currency of an article moving from one country to the other might be compared with the average price in the other currency, and in this way some relationship between the currencies deduced. For various reasons, however, the number of articles for which such comparisons are possible is surprisingly small, and the exchange values of the currencies determined from them extremely diverse.*

Examination of the reports of the output of individual industries in the two countries in the great bulk of cases appear to provide no clue which might be followed up with a view to throwing light on the relative values of the currencies. One of the few which did provide something to work upon, however, was the boot and shoe industry. The results of following up that clue are set out in the Appendix. They lead me to the view that for that particular industry (but not necessarily for any other) the appropriate rate of exchange for 1935 was in the neighbourhood of 5.50 rather than 4.90. It is impossible to explain the known facts of the footwear industries in the two countries on a value as low as 4.90, but reasonable explanations can be provided on the basis of 5.50. This means that when comparing the value of the output (whether gross or net) of the two countries, the U.K. output for the footwear industry is under-stated by about 12 per cent. by using the market figure of 4.90.

* The lack of comparability of foreign trade statistics is well exemplified by an enquiry of this character. For example, the U.S. trade return for 1935 indicated an export to the United Kingdom of women's footwear of 150,500 pairs valued at \$823,000 f.o.b. The U.K. returns for 1935, however, indicated an import of women's footwear from the United States of 315,000 pairs valued at £192,300. Clearly the inequality of the quantities renders it inappropriate to compare the average price in such cases. This seems to be quite common, and must cause some doubt to arise as to the general accuracy of import and export statistics. The few cases in which the quantities exported from the United States were in reasonable accord with those recorded as imported into the United Kingdom—e.g., not differing in quantity by more than 10 per cent.—were hams, grapes, lard, sulphur, cotton, machinery belting, tanning extracts, glazed kid and patent leather. In these cases, allowing 5 per cent. to cover the differences between f.o.b. and c.i.f. values, the apparent values of the exchange were:—

	\$		\$		\$
Hams ...	5.17	Sulphur ...	4.32	Tanning extract...	5.88
Grapes ...	3.82	Cotton ...	4.62	Glazed kid ...	5.68
Lard ...	4.98	Machinery belting	2.87	Patent leather ...	4.85

These cases cover a very small portion of the field of foreign trade between the two countries. They show figures for the exchange varying over a very wide range, and they are clearly of no value in deducing a general figure to be applicable to the external trade of the two countries, and even less to the explanation of the production circumstances of the industries involved.

Determination of "cost of materials"

(24) The next factor to refer to in the comparison of the methods of the two censuses is that of "cost of materials." The U.K. report states that to determine the amount paid for materials "the book value of stocks of materials at the beginning of the year was included and that of stocks at the end of the year deducted from the total purchases for the year." "Materials" included not only everything used in the factory—fuel, water, etc., as well as the ingredients of the articles produced—but also materials used "for repairs to the firm's own plant or buildings carried out by their own workpeople." The U.S. report states that the item "materials" "covers the combined cost of materials, containers for products, fuel and purchased electric energy." It is not clear from this whether the item "cost of materials" was the amount actually paid for such materials in the year or the estimated value of those used in the year. In addition to the probably small differences of detail regarding the articles included under the heading "materials," substantial differences may arise, as in the case of measurement of value of gross output, from the different methods of defining "cost of materials" in the two countries. The addition and subtraction of "stocks at book value" to and from "purchases at cost" for industries dealing with materials which fluctuate considerably in price and which are required by the nature of their processes to hold substantial stocks, may give a figure very different from that provided by taking merely the "combined cost of materials." The quantity held in stock may go up to as high as 100 per cent. of the quantity used in the year or down to 50 per cent., depending on the opportunity of buying at favourable prices. If Q is the quantity purchased in the year at average price p , the stock at the beginning might be $\frac{1}{2}Q$ and at the end $\frac{3}{2}Q$, and the prudent book value of the stock might be $\frac{1}{2}p$. The cost of the materials purchased in the year (the U.S. basis of "cost of materials") would be $Q \times p$. On the U.K. basis the figure to be provided would be

$$Q \times p + \frac{Q}{2} \times \frac{3}{2}p - \frac{3}{2}Q \times \frac{1}{2}p \text{ or } \frac{13}{16} Q \times p$$

In a period of falling stock the corresponding figure on the U.K. formula would be

$$Q \times p - \frac{Q}{2} \times \frac{3}{2}p + \frac{3}{2}Q \times \frac{1}{2}p \text{ or } \frac{19}{16} Q \times p$$

These are not fanciful figures. In the leather industry, if a manufacturer returned his "cost of materials" on the U.S. formula, it might well differ by 20 per cent. or 25 per cent. from that based on the U.K. formula. For most other industries the difference would be less. In times of falling prices, when manufacturers tend to increase stocks, the difference would be in one direction; in times of rising prices it would be in the other. No general indication of the effect of this consideration can be given, but its existence should certainly be borne in mind when comparing the results of the censuses for the two countries. It should also be remembered that certain relatively small items may be included among "materials" in one country and not in the other, but the effect of this is likely to be quite small.

Scope of censuses

(25) The next point to consider regarding the comparability of the U.K. and U.S. returns is that of the scope of the respective censuses. In each country

the figures for small firms were omitted from the reports, but the definitions of "small firms" were not the same. In the United Kingdom particulars of firms employing on the average ten persons or less were not included in the grand total. In the United States firms with a gross output of less than \$5,000 in the year were excluded. Professor Bowley (*National Economy*, 1942, Appendix 3) has provided a convenient summary of the estimates of the net output of the small firms in the United Kingdom in 1935. These aggregate £159,000,000, of which £56,000,000 was for non-manufacturing firms. The total net output of manufacturing firms making returns was £1,182,000,000. The net output not included in the published figures, therefore, amounted to about 8½ per cent. of the total for the whole of the manufacturing firms. I have not seen any corresponding estimate made for U.S. industry for any of the recent censuses. In connection with the 1921 census, however, a special enquiry was made on this point. This showed that 99.7 per cent. of the gross value of the products reported was contributed by establishments manufacturing products to the value of \$5,000 or more. It is hardly likely that in the United States small firms have increased in relative importance since that date. The exclusion of small firms, according to the respective definitions used, therefore, probably means that in the comparison of published results for the two countries, the British figures under-stated the total output relative to the United States by about 8 per cent. For individual industries, of course, the discrepancy might be substantially greater.

Treatment of work done on commission

(26) Another point of difference in the procedure of the two countries, but probably not of great moment when spread over the total output, is in the treatment of "work done on commission" or "contract work." In the U.K. enquiry "where work was done on goods supplied by manufacturing firms" its value was included in the final selling value of the goods returned by those firms, but "in the case of goods made on commission for merchants or other persons who made no return to the enquiry, the selling value of the goods has escaped record." In the United States, contract work was so substantial in the clothing industry that figures were separately provided in the 1935 Report for (a) "Regular Factories" and (b) "Contract Factories." The cost of the contract work was rather more than 10 per cent. of the total value of the goods produced in the whole industry. In the fur-dressing industry in this country the practice of dressing skins on contract for firms who are not themselves manufacturers is fairly extensive. It exists in certain sections of the leather industry to a small extent, and it may well exist, for all I know, in other industries in which there is a well-established merchants' section. This is a matter which I think might well receive more attention in future censuses. The omission from the British returns of records of work done on contract further vitiates comparison of the figures of output of the two countries in a direction unfavourable to the United Kingdom.

Period to which census relates

(27) A point to which a passing reference has already been made deserves a little more attention, and that is the fact that while the census reports are attributed to the output of the calendar year, only a portion of the individual returns made by manufacturers are likely in fact to relate to the output of that

year. The schedule sent to U.K. firms stated that "the period should be the 12 months ended 31st December, 1935, but returns for the business year of the firms ending between 7th April, 1935, and 8th April, 1936, will be accepted as compliance with the statutory requirements." The U.S. report states "the returns relate to the calendar year or in the case of some establishments to business of fiscal years ending within the period from April 1st, 1935, to March 31st, 1936." It is possible, therefore, that the return of an individual U.K. firm covered little more than three months of the year 1935. In view of the instruction (referred to in paragraph (21)) that the book value of stocks had to be taken into account in determining the value of materials used, it is likely that most if not all firms adopted the alternative given them of providing the data for their own accounting period rather than that of the calendar year, since they would readily have certified particulars of value of stocks for the beginning and end of this period, but would not in general have these stock figures for the beginning and end of the calendar year. The question of stocks however, does not appear to enter at all into the answers to the question on the U.S. schedule, and the likelihood is, therefore, that a much larger proportion of firms in the United States provided particulars for the calendar year rather than for their accounting period. It may well be that this lack of comparability of period does not make much difference to the aggregate results for all industries, but it may have appreciable effect in individual cases.

Classification of industries

(28) A point of importance in connection with the comparison of output for individual industries in the two countries is that of the classification of establishments into industries. Before such comparisons can properly be made we should be sure that the boundaries of the industries are the same—i.e., that if a firm is placed in a particular industrial group under the procedure of one country, it would be placed wholly in the same group under the procedure of the other. In the United Kingdom in 1935, establishments were classified into 123 different industries, "the grouping being designed to correspond as far as possible with that followed by other Government departments concerned in the compilation of industrial statistics." In certain cases some subdivision of industries was made and some results provided for the subdivisions. The report states that returns were required from a firm for each trade it was concerned with, so far as was practicable. Where the necessary particulars for each trade were not separately available, a combined return was made in which the different kinds of goods produced were set out in as much detail as practicable, but in this case the number of employees returned covered the whole of the varied output, and could not be associated with the production of particular articles.

In the United States, on the other hand, in 1935 the manufacturing establishments were classified into 340 industries. Each establishment was treated as a unit and the data reported by it assigned to some industry. In some cases an establishment manufacturing several articles should, on strict analysis, be assigned to different industries, but in fact "each establishment as a whole is assigned on the basis of its product or group of products of chief value to some one industrial classification." If the number of industrial groups in the two countries were the same, the possibility of the output of an establishment in one country being treated differently from that of a similar establishment in

the other would be small. The real difficulty arises through the much more detailed classification of industries in the United States. The fact that U.S. production was divided into nearly three times as many industrial groups as in this country (a single plant in the former country being counted as two or more establishments in some cases and these falling into two or more industrial groups) permits a clearer picture to be provided of the circumstances of the production of particular items. For example, the segregation of leather belting as a separate industrial group (which is not done in the case of the United Kingdom) shows that that industry has a high net output per person—\$4,220 as compared with \$2,140 for the whole leather-producing industry—so that the net output per operative in the leather industry in U.K. is swollen by the inclusion of leather belting and vitiates comparison of the results for the leather-producing industry in the two countries.

The difficulty of comparison in the case of the motor industry has been referred to in paragraph 16. In the case of the U.K. in 1935, 75,567 persons were employed in "manufacture of private motor-cars and chassis (including taxicabs). These 75,567 persons had a gross output of £66,526,000. But the value of the "characteristic products" (*i.e.*, cars, taxis and chassis) was only £51,385,000 (77·3% of the gross value). There were also 20,238 persons employed in "manufacture of commercial vehicles and chassis." The value of the gross output of these was £15,048,000, and that of the "characteristic products" was £11,779,000, being 78·4% of the gross value. Taking these two subdivisions of the "Motor and Cycle" industry together, 95,805 persons had a gross output of £81,574,000 but only £63,164,000 (77·5%) of this consisted of motor vehicles and chassis. 22·5% of the output (by value) of these 95,805 persons consisted of other work than making motor cars.

In the U.S. 1935 report the only figure provided having reference to the number of operatives employed in making motor vehicles was 147,044, and related to "the motor vehicle industry." The gross value of the output of these 147,044 workpeople was \$2,391,000,000. Of this \$2,391,000,000, the value of the actual motor vehicles (complete vehicles and chassis—private cars, taxis, public conveyances and commercial vehicles—3,923,000 in number) was \$2,152,000,000. Thus the motor vehicles represented 90 per cent. of the gross value of the output of these 147,044 workpeople. The remaining 10 per cent. was described as "other products" (not normally belonging to the industry) and a quite small item "receipts for repair work." The corresponding percentage for 1937 output was also 90.*

The fact that motor production was 90 per cent. of the output of the employees

* Dr. Rostas in obtaining the index of 419 (paragraph 12) as the relative physical output per employee in the motor industry for the United States and the United Kingdom respectively made some allowance for this difference in industrial classification.

In a footnote dealing with his general procedure Dr. Rostas stated, "in order to arrive at the number of operatives employed in producing the volume of output compared, it was necessary to exclude operatives producing by-products not included in the comparison or those doing repair work etc. In many cases this was possible only by assuming that the net output per head within the same industry was the same irrespective of whether the operative was engaged in producing the main product or the by-product or was engaged in doing repair work." I do not know if the case of motor-cars was one for which this assumption was made, but the U.S. reports for 1935 show that the net output per head for (a) motor vehicles was \$3,930; (b) motor vehicle bodies and motor vehicle parts was \$2,270; and (c) motor-cycles, bicycles and parts was \$2,020. For the three industries combined the figure was \$2,880. For the U.K. motor and cycle industry the net output per operative was £284.

referred to in the U.S. industry, but only 77.5 per cent. in the U.K. industry provides some measure of the degree of incomparability of the industrial groupings.

Enumeration of workpeople employed

(29) The general method of recording the number of workpeople employed was the same in the two countries, but differences of detail regarding the types of workpeople included arise. In each country the number employed in the week containing the 15th of the month was required for each of the twelve months, and the monthly figures were averaged. All wage-earners employed in or about the factory, as well as foremen, but not administrative or technical staff, were included under this heading in each country. The U.K. schedule required in addition that van and lorry drivers as well as warehousemen should also be included. It is not clear if these same classes were included in the U.S. return. Their inclusion in the U.K. return leads to inconsistent results in so far as some firms in an industry employ their own transport workers and others do not. The output per head of the former would be under-stated in relation to the latter. Over the past twenty years there has been a great change in the method of transporting and delivering goods. Previously for many industries the bulk of the work had been done by men employed by the railways, some collecting or delivering goods by horse-drawn vehicles and others engaged on the transportation by rail. By 1935, however, much of the transport had been transferred to road motors. An appreciable number of the men engaged in this were in many cases on the pay-roll of the manufacturer. In others they were employed by specialists in road transport. The question of employees engaged in transport and delivery work is one which appears to need special consideration in future censuses. It is unlikely that the procedure in the two countries in this matter was exactly the same, and the comparison of indices expressing output per head is affected by the extent to which the practice differs.

Effect of short-time working

(30) Another shortcoming in both countries of the statistics of workpeople employed has a ready been mentioned in paragraph (15). It is that it does not take account of the amount of time actually worked. If the practice in one country in periods of slack trade is to discharge some workpeople rather than to employ them all on short time, while in the other short time is practised so far as possible with a view to avoiding discharge, the comparison of any indices "per head" is impaired. Without a more detailed investigation of the data which may be available in the two countries on this matter, no conclusions as to the effect of this consideration on the various indices can be drawn. The importance of the point justifies further investigation into the problem.

Inaccuracies of returns

(31) Finally, in dealing with the considerations which may affect comparability of the results of the censuses for the two countries, we should not overlook the question of possible inaccuracies of the individual returns. There is much more scope for mistake in filling up the complicated schedule of the Census of Production than there is in filling up that of the Census of Population. It is worth while setting out in detail the official statement of the steps taken to obtain accuracy. In the United Kingdom, after eliminating all firms

able to claim exemption owing to employing not more than ten persons, "the statutory schedule was issued to the remaining firms, numbering about 152,000 at the beginning of 1936, three months being allowed for the completion and delivery of the return. Second applications were required in 82,000 cases (more than 50 per cent.) and third applications in 37,500. A final application was made by registered post to 4,000 firms whose returns were still outstanding. Legal action was found necessary in about 200 cases. About 57,500 returns were tabulated, of which about 37 per cent. were found to be defective or inaccurate and were returned for completion or revision."

The procedure in the United States in 1935 was similar to that adopted in both countries for the Census of Population, though in earlier years this had not been the case. Schedules were sent to manufacturers who were already on the Departments list. They were told to fill them in and hold them until called for by "field representatives." These latter also made a door to door canvas in order to obtain returns from all other establishments who had been engaged in manufacture in 1935 and the value of whose production exceeded \$5,000.

The U.S. method seems more likely than the U.K. to impress upon those filling up the schedules with the importance of the matter, though the method of collection by hand does not, of course, ensure accuracy of the returns.

In aggregating figures from many schedules there is no doubt much truth in the comforting view that errors tend to cancel out. Even so, however, it is prudent to expect an appreciable residuum of inaccuracy left over. It is impossible to say, however, whether this consideration does affect to any practical extent the comparability of the aggregate returns for industrial groups in the United Kingdom and the United States.

Summary of factors examined

(32) It will be convenient to give a brief summary of the various points dealt with in paragraphs (21) to (31), setting out the various factors examined with a view to discovering possible sources of error in the interpretation of the comparable figures of the two censuses. They are:—

(a) There is a difference in the methods of determining the value of gross output. The U.K. method involves the use of figures of manufacturers' stocks taken at "book value." This is not the case in the United States. For certain industries the value determined by the U.K. procedure may differ appreciably from that determined by the U.S. procedure. Paragraph (21).

(b) In both countries the figure for value of Gross Output is misleading inasmuch as it contains a good deal of duplication. This duplication appears to be rather greater for U.S. than for U.K. Paragraph (22).

(c) Any comparison of values for the two countries involves converting those values into a common currency, and this requires some assumption regarding the appropriate rate of exchange. There is no logical justification for taking the average market rate for the year (4.90 for 1935), and for the footwear industry an exchange of about 5.50 seems to be required to explain the known facts. Paragraph (23) and Appendix.

(d) The consideration mentioned in (a) regarding valuation of output applies also to valuation of cost of materials used. There appears to be some small difference also in the materials actually covered in the two countries. Paragraph (24).

(e) The scope of the respective censuses differs with regard to the inclusion of small firms. The definition of small firms adopted by the United Kingdom involves about 8 per cent. of the total output of the country escaping record. The definition adopted for the United States appears to exclude less than $\frac{1}{2}$ per cent. Paragraph (25).

(f) There appears to be a difference in the practice regarding the item "work done on commission or contract work." Particulars of the value of the goods produced on contract for firms who are not themselves manufacturers are not included in the British returns. Paragraph (26).

(g) Though each census was announced as relating to the output of the year 1935, in the case of U.K. firms figures for "financial years" ending at any time between April 7th, 1935, and April 8th, 1936, were accepted. Paragraph (27).

(h) Important differences exist in the classification of industries in the two countries and in the classification of establishments into industrial groups. The fact that the United States classifies manufacturing firms into 340 industries while the United Kingdom uses only 123 groups may substantially affect the comparison of the figures for industrial groups having similar descriptive titles in the two countries. Paragraph (28).

(i) The method of calculating the number of workpeople in an industry differs in the two countries by the inclusion in the case of the United Kingdom of employees engaged upon the delivery and transport of goods where those operations are carried out by the employees of the manufacturing firms. Paragraph (29).

(j) The reports, though providing figures of the number of people employed say nothing about the time they are occupied. The practice regarding short time in the two countries is not the same. Paragraph (30).

(k) The possibility that inaccuracies in the individual returns may have greater effect in the aggregate results in one case than in the other should not be overlooked. Paragraph (31).

Conclusions from comparisons made

(33) The examination I have made of the data of the two censuses has led me to the conclusion that they do not afford a reliable means for comparing industrial productivity per head in the two countries. It is disappointing to reach a negative conclusion, but it is important nevertheless to record it. I have considered the possibility of adjusting the index calculated by Dr. Rostas for the leather industry (U.K., 100; U.S., 176) with a view to making corrections for the various factors mentioned—*e.g.*, (1) reducing the figure of 176 by, say, 10 per cent. on account of using a more appropriate rate of exchange, (2) reducing it by, say, 8 per cent. on account of different methods of valuation, and so on. I do not feel justified in putting down any final figures, however, which might be quoted, as these corrections in themselves are to a certain extent conjectural. Comparison of the output of operatives in industry in the two countries cannot in general be made with any degree of accuracy on the basis of the Censuses of Production reports alone. There is a mass of statistics available for both countries which should apparently be capable of providing a means of comparison, but the many points of difference in the fundamental features shown by the two countries create difficulties which cannot at present be properly overcome. It is tantalizing that with such volumes of data we cannot arrive

at reliable comparative figures for productivity of the operatives in the two countries. The adjustments in the Census instructions needed to overcome the difficulties which have been pointed out would not involve much trouble on one side or the other. The sole reason for the censuses of manufactures hitherto taken in either country has been to serve national purposes. While continuing to serve those national purposes, they could readily be made to serve the wider purpose of international comparability. So far as I know there has never been consultation between the statistical officers in the two countries with a view to adopting common procedure in this matter. As the U.S. census had been regularly taken for two generations before we started to collect any information, it is highly probable that those in charge of the first British census made use of the published experience of their opposite numbers in the United States. Whether it would be practicable to have exactly the same basis of procedure in every respect—*e.g.*, the same system of valuation, the same number and range of industrial groupings, the same treatment of work done on contract, etc.—it is difficult to say. Certain differences in the industrial structure of the two countries have to be recognized (*e.g.*, there is bound to be differences in the proportion of duplication in the gross value of output), but if it is really desired to make close comparison of the manufacturing productivity of workpeople in the two countries, relatively little change in the arrangements would be needed to bring this about. It does not seem to be asking too much to have (a) a common method of valuation, (b) the same number and descriptions of industrial groupings, (c) a common definition of the size of firms to be excluded, (d) uniform treatment of work done on contract, (e) the same convention regarding the exclusion of ancillary workers, etc. The Governments, however, are hardly likely to move in the matter unless representations are made to them, and it is first necessary to find out whether there is sufficient strength of opinion in the two countries as to the desirability of doing so. I suggest that the first stage is for the Statistical Societies of the two countries to consult, and if there is agreement on the point at that level, then each Society might make representations to the Government concerned.

(34) In spite of having reached a negative conclusion regarding the usefulness of indices of productivity obtained from Census of Production data, I should like nevertheless to make a few remarks on the subject of the interpretation to be put upon such indices. Most of the published statements quoting the indices have assumed without any apparent hesitation that they provide a measure of efficiency of labour. Dr. Rostas assumed that industrial efficiency was measured by production per head—both by physical output per head and by value of output per head—while Sir George Schuster quoted the indices as throwing light upon the question of the relative efficiency of industry in this country and in the United States. Such a view appears to me to concentrate attention only on the quantum of production, and to ignore altogether the quality factor. Assuming that it may become possible in due course to compile statistically satisfactory indices for comparing industrial output per head in the United States and the United Kingdom, and assuming that the indices for the former do turn out to be higher than those for the latter, what inference will it be proper to draw from that comparison? Without other information, all that can properly be deduced is that 100 workpeople in the United States turn out a greater number of articles than do 100 workpeople in the United Kingdom. But this might equally well indicate inferiority of work-

manship rather than superiority of industrial methods. If the 100 plus X pairs of footwear turned out by a particular number of operatives in the United States last longer than the 100 pairs turned out by the same number of operatives in the United Kingdom, I grant that the superior efficiency of the U.S. industry would be demonstrated. There is evidence, however, that they do not, and I am given to understand that the same is true of motor-cars. Some measure of the service the article is capable of performing, as well as the number of articles produced, must be incorporated into any statistical index purporting to represent efficiency. Hides and skins can be converted, after processing them into leather, into footwear suitable to last the wearer either one month or two years. Far more of the former kind can be turned out in a stated period and with a specified number of workpeople than of the latter, but is it really more meritorious to aim at producing boots and shoes to last one month rather two years? If we are trying to discover an index of efficiency, we must be careful to avoid adopting one which can equally well be applied as an index of shoddiness. Ruskin remarked long before the age of mass production, "There is hardly anything in the world some man cannot make a little worse or sell a little cheaper, and the people who consider price only are this man's lawful prey." If we fall into the fallacy of recognizing speed as the main aim of manufacturing output, it is impossible to foresee what records of "efficiency" may ultimately be set up. The raw materials which can be made available for many industries seem almost limitless, but for those industries for which raw materials are limited and cannot be greatly increased, a more suitable definition of efficiency would be one based upon the idea of getting the greatest possible use out of those materials. This idea, in the present state of opinion on mass production, may seem chimerical, but it may serve to some extent as a brake upon going to the other extreme and unduly extolling rapidity of production.

(35) I should like to finish this Address, as I began it, on a general note, and refer to the rôle which statisticians as "fact-finders" should play in post-war international reconstruction. With a fairly extensive experience of negotiations both on a national and international plane, I have been more and more impressed with the importance of "getting the facts right" as a preliminary to attempting to get any working agreement. Innumerable conferences have made little headway, even if they have not come to grief altogether, because the participants have not had a clear common understanding of the facts involved. When there is clear common understanding of the facts, agreement is generally not difficult—at any rate when the participants are practical people meeting with the objective of finding some mutual working arrangement. But this process of finding the facts and of seeing them from the angle of the people on the other side of the table may be difficult and need hard work and patience. In some respects I would liken it to the hard work—amounting sometimes almost to drudgery—which has to be experienced in mastering the rudiments of a game if the player is determined to become outstanding at it. If we are to have more effective international co-operation after the war than we had before, this preliminary stage of "mastering the facts" must be gone through, however arduous it may be. Indeed, the willingness to go through the drudgery of obtaining and mastering the facts might almost be adopted as a touchstone of sincerity in desiring practical co-operation. Good intentions alone are not sufficient to bring about international understandings on great problems. Getting a proper insight of the other side's point of view is equally important,

and this involves a thorough knowledge of the facts on which the other man has formed his opinion. The prospects for successful post-war co-operation on some of the most urgent industrial problems—e.g., division of available raw materials—are not bright, but they will be improved if it is generally recognized that the first stage towards any agreement is a thorough mastering of all the relevant facts. It is the statistician's job to get these facts, and to present them in a form which will give a reasonably true picture of all sides of the problem.

APPENDIX

On the rate of exchange appropriate for the comparison of the footwear output of the United Kingdom and the U.S.A. in 1935.

According to the Censuses of Production of the two countries, the average price of U.S. men's footwear was \$2.17 and of that of U.K. £0.418. The question arises as to what assumption we can make regarding the relationship between the average U.K. man's shoe and the average U.S. man's shoe (for brevity I use throughout the term "shoe" to cover both boots and shoes). If we made the simple assumption that the average in the one case could be equated to that in the other, we should reach the conclusion that e was \$5.2 to the £. Although this assumption is certainly much nearer the truth, for the purpose of comparing the output of the footwear industries in the two countries, than that of "the market rate" adopted by Mr. Rostas (leading to $e = 4.90$), it is possible, I think, to make other assumptions which will approach nearer to the truth. The fact that there was export trade from this country to the United States in high-grade men's footwear but no export from the United States to this country of men's footwear, suggests that the average man's shoe in this country was higher in the scale of production value than that in the United States. Instead of the simple formula $2.17 = 0.418e$, we can make a closer approximation by modifying that equation to $2.17p = 0.418e$, where p is greater than 1. If it is 5 per cent. greater, then $e = 5.45$. If it is 10 per cent. greater, then $e = 5.71$.

In the case of women's shoes, the respective averages are \$1.920 and £0.353, and the simplest assumption that the average in one case can be equated to that in the other would lead to an exchange of \$5.44 to the £. To get approximately the same value of e in the case of both men's and women's footwear requires the assumption that the average U.K. man's shoe stands 5 per cent. higher in the scale of production value than does that of the United States, while the corresponding average woman's shoe stands at approximately the same in the scale in each country. This is the only way of getting a consistent value of e for both men's and women's footwear on the simple assumption made. In the case of women's footwear, the trade tendency is in the opposite direction from that of men's—that is, there is some export trade from the United States to this country. The extent of this is, however, relatively smaller than for the opposite tendency in the case of men's footwear. To a first approximation accordingly, the value of $e = 5.45$ seems a reasonable one to explain the facts relating to men's and women's footwear production and trade in the two countries.

It is possible, however, to go into further details and to closer approximation. The average value of the footwear can be considered as made up of two parts: (a) that due to materials and (b) that due to net output—mainly process costs, of which the U.S. returns show that wages account for approximately half. Taking

the footwear industry as a whole, the net output in the case of the United States in 1935 was 48·15 per cent. of the gross value of the output, while for the United Kingdom, the corresponding figure was 46·88 per cent. It is not a big assumption to make that those particular proportions apply separately to (1) men's footwear alone and (2) women's footwear alone, since the former represents about one-third of the total and the latter about 40 per cent. The average price of \$2·17 for U.S. men's footwear, therefore, can be considered as being made up of \$1·125 for materials and \$1·043 for net output, while the £0·418 for U.K. men's footwear can be considered to be made up of £0·222 for materials and £0·196 for net output. We can compare separately the items for (a) materials and (b) net output for the two countries.

There is evidence that the value of materials used generally in producing footwear in the United States is higher than in the United Kingdom independently of the relative positions of the average shoe in the scale of production values. The chief reason for this view is the fact that there was an import duty of 10% on the main raw material imported into the United States, this duty being put on with the expressed intention of raising the price of the large supplies of domestic hides and skins in the United States. There was no such duty on imports into this country. Moreover, there were substantial duties on the importation of leather into the United States. It is true that there were some duties also on the imports of leather into this country, but they covered only a small portion of the total imports (owing to Empire preference). This higher price per unit of quantity in the United States is not offset by a corresponding smaller quantity of material per pair. There was in 1935, more mass production of footwear in the United States than here and this tends towards bigger waste in cutting or alternatively to the use of higher grade material which permits of better cutting.

On the other hand, it may be that the process costs per pair (the chief single ingredient in net output) in the United States were less than in this country. Although, as I show above, there is much difficulty in comparing the physical output per head in the two countries, it is probable that the figure is higher for the United States owing to the greater use of mass-production methods, though it is possible that this to some extent is balanced by other items in net output—e.g., greater profits. The evidence of differentiation between the two countries under the heading "net output" is considerably less than in the case of "materials," and it is not possible to say to what extent the two will balance. Certain assumptions can, however, be made and are referred to later.

The considerations I have outlined will lead now to the following equations :—

(a) From consideration of materials $1·125 + x = ·222e$

(b) From consideration of net output $1·045 - X = ·196e$, where x is the higher value of the materials in the U.S. average shoe and X the lower net output as compared with the average U.K. shoe.

These conclusions were reached, however, on the basis of equating the average footwear in the two countries. If we assume that the material in the average man's footwear in the United Kingdom is $(p - 1) \times 100$ per cent. in the scale of production value above that in the United States, the figure of 1·125 in the equation would become $1·125 \times p$, while the figure of 1·045 would become $1·045 \times q$, where $(q - 1) \times 100$ per cent. is the amount by which the net output

in U.K. men's footwear exceeds that in U.S. men's footwear. Thus (a) and (b) become

$$\begin{aligned}(a') & 1.125p + x - .222e \\ (b') & 1.045q - X = .196e\end{aligned}$$

If, finally, we make the assumption that $\dot{X} = nx$ (that is that the advantage to the U.S. industry in net output is n times the disadvantage in extra materials) we are led to the following value of e

$$\frac{1.125pn + 1.045q}{.222n + .196}$$

For different values of n , this value of e can vary only between the limits of 5.33 q and 5.07 p .

Applying the same procedure to the data for women's footwear, we reach the following equations:—

$$\begin{aligned}(a'') & .996P + y = .188e \\ (b'') & .924Q - Y = .165e\end{aligned}$$

and assuming $Y = my$, $e = \frac{.996mP + .924Q}{.188m + .165}$

For different values of m this can vary between 5.60 Q and 5.30 P .

Thus we have the two ascending sequences

$$\begin{aligned}5.33q; e; 5.07p \\ 5.60Q; e; 5.30P \\ \text{when } e = 5.5p \geq 1.085, P \geq 1.038 \\ e = 5.4p \geq 1.065, P \geq 1.019.\end{aligned}$$

As the value of e diminishes below 5.40, so will the values of p and P diminish towards unity. The clearest piece of evidence, from some knowledge of the actual trade, is that p and P should be somewhat greater than unity. It is not possible from trade knowledge to get clear ideas of the most appropriate values of q and Q . On the whole, I am inclined to the view that a value of $e = 5.50$, involving the assumption that the value of materials used in the average man's and woman's shoe in the United States is about 3 or 4 per cent. higher than that in the United Kingdom, is the most appropriate, but to have a value of e as low as 5.0 requires values of p and P which are not consistent with trade knowledge, and on the whole I come to the conclusion that a value of e in the neighbourhood of 5.50 seems best to fit in with trade knowledge.

I had hoped to have made some similar calculations regarding leather production in the two countries. Unfortunately, however, this is impossible. Speaking generally, leather falls under two main headings—namely, that sold by weight and that sold by area—and a comparison of the average prices in the two currencies of that sold by weight and, again, the average prices of that sold by area might have led to some interesting results. Unfortunately, however, although the U.K. Census figures for this industry are expressed in terms of units of weight and of area respectively, the U.S. reports merely provide quantitative figures by numbers of pieces and not by weight or by area.

It would be of interest if statistical workers with some detailed knowledge of other industries would make comparisons similar to that given here for the footwear industry. My cursory examination of the reports for other industries in the two countries indicates that not many of them lend themselves to this form of comparison. The information does, however, appear to exist for the

output of woven materials both in (a) the cotton industry and (b) the woollen and worsted industry, as output in each case is expressed in terms of two units of quantity as well as of value. I would not, however, venture, myself, to make the comparison, as it is clear that practical knowledge of the trades concerned is necessary for intelligent interpretation of the figures.

DISCUSSION ON PRESIDENTIAL ADDRESS

MR. LEAK said it afforded him great pleasure to be the first to welcome Dr. Snow to the Presidential Chair. He had served the society excellently well in the capacity of Secretary since 1930 and the honour now conferred on him was well merited. Mr. Leak regarded his election at this juncture as particularly timely. As the President had outlined in the opening paragraphs of his Address, the Society had much work to do in this planning era, and Mr. Leak could conceive of no one better fitted to guide our affairs at this time. Dr. Snow was largely instrumental in the formation of the Industrial and Agricultural Research Section and had concerned himself with its war-time development into the Industrial Applications Group. He was thus admirably fitted to be in the Chair when, as everyone confidently expected, the Society would have to consider the post-war development of that side of their work.

Dr. Snow had made an innovation in regard to this meeting. It had been the rule from time immemorial that Presidential Addresses are sacrosanct, and that the ex-Presidents proposing and seconding the vote of thanks could only indulge in generalities. This was a very useful rule to have when the Chair may be occupied by distinguished outsiders who might legitimately be fearful of the den of lions the Society had at times shown itself to be. Dr. Snow desired that the rule might be waived on this occasion, and Mr. Leak hoped that this might become the practice of future Presidents who were practising statisticians. It afforded an opportunity to the extinct volcanoes, as Lord Stamp once dubbed those who had passed the Chair, to do a little spluttering instead of merely guttering as they were previously condemned to do. It also gave certain Fellows the opportunity of throwing brick-bats or bouquets as they felt inclined.

Personally Mr. Leak felt that the paper earned a large bouquet. It was most necessary that someone at some time should examine the validity of the basis of the figures published by Dr. Rostas. As the President had so admirably pointed out, the qualifications were numerous, but whatever the qualifications, the lesson that in many respects our manufacturers have a good deal to learn from a study of American methods stood out a mile. Mr. Leak had no doubt that, contrariwise, we could give the Americans a few wrinkles. That we have learnt a good deal is evident from the very great economy in man-power and material that had been achieved during the war.

On the general subject of comparability of statistics internationally and co-operation between statisticians working on the same subject in different countries, Dr. Snow had not referred to the most important international development, namely, the International Convention relating to Economic Statistics promoted by the League of Nations and signed in 1928. That Convention itself provided for international co-operation by requiring all parties to exchange information about their respective statistics and for international co-ordination by laying down general principles. The International Institute of Agriculture and the I.L.O. were both in existence before that and each was concerned with uniformity in the fields of statistics respectively covered. The International Convention of 1928 was, however, the most potent influence towards uniformity in fields in which it had been conspicuously lacking. Subjects covered by the Convention included overseas trade, censuses of population, agriculture, mining and industrial production and index numbers of prices and industrial production. Provision was made in the Convention for the elaboration and development

of the principles laid down. This was done by means of a Committee of Statistical Experts, of which Sir Alfred Flux was one of the original members, and so remained after his retirement from the Civil Service in 1932. Membership was personal, not official, though as the statistical field covered related to Government statistics, only those well acquainted with such statistics were appointed. The method of working was to draft a scheme with the assistance of such experts on the subject as the Committee thought fit, to circulate this to Governments for their observations and when these were received to prepare a final report which was put up to the League of Nations and recommended to Governments for their adoption. In its last report the Committee said that they had decided to take up the problem of industrial censuses and of industrial production statistics, and were proposing to deal with the statistical measurement of national income. Had war not interrupted the work of the Committee, there would have been standards laid down in respect of many of the individual matters of non-comparability to which attention is directed in this paper. There is scope for a body like the International Statistical Institute in addition to the Committee of Statistical Experts. The Institute, or any similar body that may come into being after the war, can act as a kind of Research Association, bringing together from all parts of the new world new ideas and methods and the results of trying them out in individual countries. In time there will be built up in different countries statistics covering the same subject, but probably differing in scope and method. It is at that stage that the Committee of Statistical Experts come in and by an expert examination of all the statistical methods dealing with a given subject endeavour to prescribe definitions of terms and methods of compilation that are recommended for universal acceptance.

In paragraph 14 Dr. Snow suggested that the correct method of adding dissimilar things together was to weight the output of different types by factors representing the amount of physical effort involved in making them. Mr. Leak did not share that view. Labour was not the sole factor. Organization and machinery were most important. If one kind of shoe selling at a given price had to be produced by hand and another could be produced by machines with only a minimum amount of labour, why should the former necessarily be weighted much more highly than the latter? He did not regard gross output value as entirely satisfactory either. Net output took into account machinery as well as labour and other factors of production, and it was the method universally adopted in adding together dissimilar products for index of production purposes. Cost accountants might assist in determining within an industry the factors appropriate to differing types of shoe or motor-car, for example, and there was a lot of rather indigestible material in the Census of Production individual returns. Sub-division by selling value per unit was not a bad substitute, but an average for one description was not very good. It really was necessary to distinguish between a Ford and a Rolls Royce in the over 20-H.P. class. Quality came into it.

The method of valuation was, except in times of rapidly changing prices, not widely different in the United States and this country. The Board of Trade would have liked to get the selling value of all goods produced in the year, but the existence of unsold stock at the beginning and end of the year was a real difficulty. They were advised that the method of valuation adopted was the one manufacturers could provide most readily from their accounts, and unless the system of accounting in the United States differed from ours, Mr. Leak expected the United States would get much the same kind of valuation as the United Kingdom. No precise rule had been laid down in this country; they had left it to the discretion of the individual manufacturer. And similarly as regards cost of materials. Stocks being valued at cost or at market value, whichever is the lower, the influence of stock valuation on net output, even if stocks are stable, could be very large if prices fall rapidly, as they did in 1930. The United States obtained in 1937 for the first time the aggregate value of stocks of goods and of materials, and Fellows might be interested to know that the Board of Trade's post-war plans provided for obtaining information on this point and on

many others about which present information in this country was less complete than it might be. Mr. Leak did not know, of course, whether Parliament would endow the Board of Trade with the powers to do all they wanted or, what was equally important, whether manufacturers would be willing to furnish the information. The intention was to make the Census of Production an annual affair—some progress in that direction was being made before the war.

Duplication in gross output is a most fruitful source of error as affecting comparability of statistics, and too much stress could not be laid upon it. The United States figure was not comparable with that for the United Kingdom. The United States Census leaves out mines and quarries, most of whose output was probably duplicated in the industrial census; it also leaves out building, whose materials would mostly be duplicated in the output of the manufacturing industries recorded. Accordingly Mr. Leak would expect the United States figure on a comparable basis to be much lower, duplication probably being even greater than in the United Kingdom, as they use less imported material. Their method of calculation also appears to leave out the difference in value between intermediate products as output and as materials, owing to the cost of transport from one place to another.

Mr. Leak thought that in his remarks in paragraph 28 Dr. Snow had not done justice to the amount of information published in the Census of Production report about the motor and cycle trade. Information was published about 6 groups of separate kinds of manufacturers; these were firms engaged primarily in the manufacture of (1) private cars and chassis, (2) commercial vehicles and chassis, (3) motor-cycles, (4) pedal cycles, (5) motor bodies, and (6) other parts and accessories. The Board of Trade could have treated these as separate trades had they wished, but it was more desirable to treat the trade as a whole in view of overlapping, and it is interesting to note that in the United States Census for 1939 they had combined the two trades they previously had relating to complete motor vehicles and to parts of motor vehicles in view of the great amount of duplication that was thereby caused in the total Census figures.

The production of complete vehicles being regarded as a separate trade in the United States, one could well understand there being a very high output of complete vehicles by the employees of firms engaged essentially on assembly work. In his calculations had Dr. Rostas taken into account these persons only, or all those engaged in the manufacture of parts, and what had he done precisely for the United Kingdom?

Mr. Leak did not regard the difference between our own and the United States Census of Production years as having any significance for industry as a whole. For individual trades it could be important—firms in the brewing trade, for example, mostly use the September year and one had to take this into account when calculating the duty payable. The mean ending date for all returns in the leather trade was almost exactly the end of the calendar year.

The relevance of short time or overtime mentioned in paragraph 30 was admitted, but it is not significant when comparing output per operative in this country and the United States. Their hours are so much shorter than ours that many of the workers on short time in this country would be regarded as working overtime in the United States. It only affects relative output from year to year here, leading to low physical output per head if trade is slack, and high if trade is booming.

It might be news to most Fellows that the article by Dr. Rostas did not break new ground. The subject had interested (Mr. Leak's) predecessor, Sir Alfred Flux, and in the *Quarterly Journal of Economics* for November 1933 Sir Alfred compared United Kingdom and United States production for the years 1924 or 1925, and carried on the comparison up to the United Kingdom Census for 1930, for which final data were not available. He found that both wages per operative and net output per person in the United States were more than double the United Kingdom figures and he tried to find out why. These were both value figures, and having investigated a number of cases, he said that "the illustrations provide little reason for assigning to differences in price levels in

the United States and in the United Kingdom the somewhat striking contrasts" shown. On the other hand, the mechanical power available per person employed was always greatly higher in the United States, and the physical output there was above ours very much in the same proportion as the mechanical power. One striking example would suffice. In the production of pig iron the mechanical power per 1,000 tons of iron was 38 H.P. in each country. The United Kingdom figure was 10 H.P. per person employed, the United States figure 44 H.P. Sir Alfred, having examined the data, said, "It appears impossible to escape the evidence of a larger physical output, per person employed, in the United States than in Great Britain, an output more than double as great in the former country as in the latter. Of marked variation, or secular increase, in this proportion, the evidence is not conclusive." Dr. Rostas, dealing in detail with the data some ten years later, came to the same conclusion as Sir Alfred Flux, and notwithstanding the many qualifications, the result was in essence unescapable, and was accounted for by fundamental differences in the development of industry in the two countries. It looked as though we must strive to improve our physical output per head by increased mechanization, and so give workers both more money and more leisure.

In saying this he had not overlooked the all-important question of quality, to which the President rightly called attention at the end of his Address. We must not only produce bread-and-butter goods, but goods which have in them such superior workmanship that they will sell in world markets. As practically all our raw materials are imported, we must put as much added value into them before we export them as we possibly can.

Mr. Leak was personally extremely grateful to the President for the analysis he had made of the factors affecting international comparisons of industrial output. He thought he was to be congratulated on having found time to write an Inaugural Address, the first, as he said, during the war, and Mr. Leak was sure the Society would wish to accord him a very hearty vote of thanks, which he had great pleasure in moving.

SIR GEORGE PAISH, in seconding the vote of thanks, said: I am myself most interested, not so much in the comparison of industrial output, as in what Dr. Snow said at the beginning and end of his Address concerning the necessity for more information, the demand of the statistician to the world to provide the information necessary for the education of the world. In my judgment we are at the greatest period in the world's history. We are now conscious of living in a world, and no longer merely in our own country, and today each one of us is in some degree responsible for the world. If we are to live up to our responsibilities, therefore, we must have information. It is vitally important that some great statistical institution should be formed to provide the statesmen and peoples of the world with all the information they need in order to understand the principles and devise the policy necessary to create a prosperous world living in peace and fraternity.

It is a duty upon us more particularly, as well as upon our American friends, to see that the Atlantic Charter is carried out in fact, not merely in words. We have to help to free the world from want—a big task when one remembers the number of people who are still far below the Beveridge line. It is a great task and a great responsibility, but it is also a great honour that we should live at a time when such things are advocated by the leading statesmen of the world. No greater document, in my opinion, has ever been placed before the nations than the Atlantic Charter, but if we are to honour it and to do the things which of necessity must be done if its principles are to be honoured, we must be informed, and we need to be informed by scientists. We must bear in mind that political people are biased. It is exceedingly difficult for political people to state the whole truth. But statisticians are men of science, and they must try to state the truth and nothing but the truth. It is for the statistician, the economist, the man of science to see that the Atlantic Charter is honoured. I do not believe it can come in any other way. It must come from the spread of truth and

understanding of all the factors that go to make for human well-being and happiness.

Therefore I welcome this part of the President's Address wholeheartedly. It is vitally necessary that we should bring into being an International Institution of Statistics. I should like to pay my testimony to the work done by the League of Nations Committee. There is no doubt that the information produced at Geneva and distributed therefrom was of great value, as also was the work of our own society, to the statesmen and people of this country and of others. But we need more than that. We need an organized scientific body that will produce true statements about a multitude of things. Take the question of national income. How are we to know what national incomes are? Try to compile the national incomes of all the countries that do not produce any statistics. What is the income of Japan, of China, of India? No one knows, although there may be guesses. Then, again, we have to go beyond the money income to find out what are the real incomes of the nations, how much their incomes will buy—how much food, clothing, what kind of houses, all that goes to make real incomes. It is a great task, but I am convinced it is going to be done, and I am glad to think that it may be done in this country under the leadership of the Royal Statistical Society. I have great pleasure in seconding the vote of thanks to Dr. Snow for his most admirable paper.

MR. HENRY CLAY said that to point out the difficulties and dangers in the use of vague statistical data was one of the most important functions a Society could perform, and the President was exceptionally qualified to carry out that service because he added to his statistical technique a knowledge of technicalities in an important group in industry. In congratulating Dr. Snow, he wished also to extend his congratulations to Dr. Rostas on his paper in the *Economic Journal*. This was, he believed, only a by-product in an important extended inquiry which Dr. Rostas was undertaking, and he had thought, rightly, that to put the available data on record would be a convenience to other students. He was to be congratulated on the fact that the first Presidential Address given to the Royal Statistical Society since 1939 had been devoted so largely to the subject which he had brought forward and the methods he had used, and he did not think he could be blamed if other people had drawn inferences from his statements which he himself was careful not to draw, and against which he had warned them.

The President's conclusion was that the two Censuses of Production under consideration did not afford a basis for comparing physical production in the two countries concerned. This did not mean that a study of the two Censuses was irrelevant to a study of the comparative productivity of the two countries. He himself had been at great pains to show how the statistical data could be used with greater safety and more refinement. But it was a common experience in a statistical enquiry to find that the data did not answer the questions with which one approached them, although they might throw light on a great many other points which had been overlooked, and even suggest extremely interesting questions that one had not asked of them.

The setting out of the results of the relevant Censuses of Production was the first and necessary step in any attempt to compare productivity in different countries. It threw up such obvious elements in the answer as the importance of continuous uniform production in affecting physical volume of output. He was sorry that in the discussion which had followed Dr. Rostas's paper no one had dealt with two questions which that paper had presented. The first of these was whether there was any significance in the fact that in the country with the lowest output per head the proportion of net product going into wages was highest, and vice versa; and the other was that apparently, on such rough comparisons as were possible, although output per head was double what it was in this country, real income per head in the U.S.A. was slightly lower than in this country.

There was only one point he desired to take up on the general question of comparison of productivity, and that was the limitations in the concept "net

product." It was a value concept, not a physical quantity concept. The Census of Production was forced to use it because the value of the product was the only general common measure which could be applied for the purpose of comparison between industries producing different things. But even in domestic comparisons its use required care, and for international use he would always prefer the direct comparison of physical volume of output trade by trade.

If one looked at domestic comparisons during the present war, the "net product" per head in the coal-mining industry, for example, had steadily gone up, but the number of tons of output per man had steadily gone down. That was because the net product was a value figure, it was the value of the product less the value of the materials used in producing it. The President had insisted, rightly, that the element of wages was important in net product. If one had a big difference in levels of wages between one country and another one would expect a difference in net product, but it would not be safe to infer that there was any difference in physical productivity. In fact many of the instances placed before them showed that there might be a rise in the net value of the product and a diminishing net physical product.

Again, if women's labour were substituted for men's in a process, after a period of years when wages had settled down, probably the net value of the product would be lower, but it was not at all certain that the net physical volume would not be higher. Women's wages were lower than men's, and therefore net value went down.

He thought that this had some bearing on the very interesting discussion which the President had introduced on the appropriate exchange rate to be applied. When he was in Washington the previous year he shared a house with a colleague, and they paid their half-time coloured servant 60 dollars a month and food. That, he supposed, was her "net output." The amount of work she did was certainly not more than the amount of work an English maid would do for £6 a month. The President might say that the appropriate rate of exchange was 10 dollars to the £, but that did not seem to him quite satisfactory. What they were trying to find was the relative productivity of the two, and they brought in the exchange rate only as an aid to that calculation. But the President, as it seemed to him, assumed a relative productivity and from that inferred an exchange rate. On that line they would require to have a different exchange rate for every comparison. The exchange rate which the President had criticized in the shoe industry—4.90 dollars—was a fact. It was the resultant, not of a comparison of the shoe industry in the two countries, but of a whole mass of transactions affecting all sorts of trades and the relations between the whole of the sterling area and the whole of the dollar area.

But if they might accept the President's argument that there was a difference of 60 cents in the £, he thought the fact was rather interesting, as it did not seem to have had much effect in promoting American exports, and that suggested to him that possibly the exchange value of a country's currency had less potentiality in affecting its export industry than it was fashionable to attribute to it.

He fully supported Mr. Leak and Sir George Paish in saying how much Dr. Snow's work for the Society was appreciated, especially in developing this most important subject.

MR. GEOFFREY CROWTHER said that as a visitor to the Society he had no intention of traversing the statistical elements in this problem. He had had the opportunity of perusing the MS. of the remarks which Dr. Rostas, he hoped, would presently make, and he believed that Dr. Rostas could put up a good defence for himself.

The point to which he wanted to address himself was a point of public policy arising out of the discussion. He agreed with Mr. Leak that the outstanding fact which emerged from any comparison of this sort was that the productivity in the United States was substantially greater than in this country. It was essential to refine statistical methods so that they might say exactly how much more, but that it was substantially larger—twice as large or more—he had in his

mind no doubt. Apart from the evidence of Dr. Rostas's calculations and Sir Alfred Flux's similar calculation, he would mention the most obvious and general evidence, namely, the national incomes of the two countries. When allowance had been made for the larger proportion of agricultural population in the United States, it was quite impossible to understand the comparison between the incomes of the two countries, at any reasonable rate of exchange, without assuming that productivity in the United States was very much larger than in this country.

He feared lest the President's address might be read in some industrial quarters in this country as an invitation to complacency. It left on the mind of the reader the impression that when all the adjustments he suggested had been made there was very little difference in productivity between the two countries and such differences as remained could be explained on the score of quality. If that was the President's intention, he must take issue with him.

He desired to say a word on the question of quality. It was customary to say that British goods were of much higher quality than those of other countries. It was one of those charming little beliefs which Englishmen held, or liked to think they held, such as that an Englishman's word was his bond, although the adjective applied to us in other countries was "perfidious." It was like the Duke of Wellington's remark on the English climate, that in summer it was perfect, and in winter no country had a better. He did not believe that British goods were better than American. There were some industries, no doubt, of which that could be said. But take the example of the motor-car. He had owned and driven American cars, and he found as between these and British cars the greatest difference in quality in favour of the American product. If the American car lasted fewer years than the British, that was not a question of quality, but of fashion. In America people threw their cars away when they had still many years of wear in them.

Going back to the question of physical productivity, he took up a reference in Mr. Leak's remarks in which he had recalled Sir Alfred Flux's calculations of some years ago. Sir Alfred Flux set himself, not merely to establish the figures, but to ask "Why?" That was a question which they should ask themselves. They should also ask what could be done, as a matter of practical policy, about these differences in productivity. This was perhaps not a task for the Royal Statistical Society, or even for the Royal Statistical Society and the Royal Economic Society in collaboration; but he would suggest that a book might be written by the two Societies together, and if it were not that the title had already been used, it should be called *The Wealth of Nations*.

What caused the wealth of nations? It might be capital, but if so, why was it that some countries had more capital than others? Why the greater amount of horse-power per pair of hands in the United States, and therefore the greater productivity of the United States as compared with this country?

This led him to his last remark, in which he wanted to support the suggestion that there should be a great and rapid advance in international investigation of these statistics by an international body, either the League of Nations body continued or some other. But two things must not be forgotten in so doing, namely, the need before these discussions were concluded of getting on with the discussion of "Why?" and "How?", and, secondly, in such a discussion, making the fullest use possible of such valuable *prima facie* material as arose from such investigations as those carried out by Dr. Rostas and by Sir Alfred Flux.

MR. MERWIN said that he agreed most heartily with a number of the criticisms which had been made on the Address. It had been a most interesting Address, putting forward a number of points which could be explored further. Additions might be made to the examples which had been given. One such addition was the striking difference as between the output of coal in this country and in the United States. As far as the useful life of automobiles in the two countries was concerned, cars in the States were used differently from the way in which

they were used here; they went longer distances and were faster, whereas over here there was not the same necessity for distance and speed.

He wished to add one more international organization to the list of those which had already been mentioned, namely, the Inter-American Statistical Institute, which was organized a few years ago. Although it had not done much as yet, it held possibilities for international co-operation, at least in the Western Hemisphere.

It would have been helpful if the President had generalized on the incomparability between the Census of Production and of Manufactures in this country and in the States. If he had done so he would have reached the conclusion, the speaker believed, that some of the differences were statistical and others structural, the latter inhering in the basic differences between the two economies, and he would also have found that the same general tests of comparability could be applied to international comparisons of national income.

One more comparison might be added to those which had been made concerning the productivity in the two countries and which supplemented the illustration from coal-mining, namely, with regard to munitions output. A comparison had been made in which very much the same conclusion was reached as had been put forward by Dr. Rostas concerning all manufacture. In this comparison the exchange rate used was 6½ dollars to the £.

Concerning the detail in which American statistics were available it might be interesting to consult the Censuses of 1939 and 1929 as well as 1935. The Census of 1935 was not nearly as detailed as in other years and the Census of 1939 would have permitted a more refined comparison.

On the troublesome question of short time, a series of studies had been made in the States in the form of detailed attempts to present the output per man-hour, which got away from the "per man-day" problem.

Finally, concerning the proposal for a new international statistical institute, it might be well to rely on whatever international organization was set up on the political level after this war was over. It might be presumed that some kind of international political organization would be set up, and that would be the right place to have a statistical organization. They in the American Statistical Association would be glad to have any interchange of ideas with the members of this organization.

DR. ROSTAS:* I am very grateful to the Council of the Royal Statistical Society for having invited me to take part in the discussion of the President's Inaugural Address. This Address puts forward a number of observations on my paper in the *Economic Journal*, April, 1943. Dr. Snow, after summarizing the factors he has examined, comes to the conclusion that "the data of the two censuses do not afford a reliable means for comparing industrial productivity per head in the two countries."

Dr. Snow in his summary mentions eleven different points of criticism, but in the text there are scattered a few other points, with some of which it will be also necessary to deal. These criticisms are partly directed at the comparability of the two Censuses in general and the definitions of gross output, but are irrelevant for comparing—as I did in my paper—physical productivity per head or the values of net output. One point—about the appropriate rate of exchange—is relevant only for my Table VI—comparisons in value of net output per head—but not for comparisons of the volume of output per head. The points relevant for the comparisons of physical productivity are:

- (1) the periods used for comparison;
- (2) the methods used for reducing different types to homogeneity;
- (3) the question how the number of people engaged in producing a particular output is determined;
- (4) the effect of short-time working;
- (5) the factor of differences in quality.

* Dr. Rostas's contribution was expanded in writing after the meeting.

I want to deal mainly with these points, and to show that Dr. Snow's criticism leaves my methods and the broad picture as regards comparative productivity unaffected. I will also show that to the extent his arguments are valid they make my comparison even more favourable to the United States rather than (as he suggests) change it in favour of the United Kingdom.

(1) *Periods used for comparison*

As Dr. Snow himself emphasizes, comparisons of physical productivity must take into account the degree of utilization of capacity of manpower and (I would add) of equipment, because output per head varies with the degree of unemployment and excess capacity. Now, 1935 was a year of depression in the United States, to a far greater extent than in England. This is shown both by relative indices of output and the indices of output per head.

	Taking 1929 = 100			
	1935		1937	
	U.S.	U.K.	U.S.	U.K.
Output	78	109	103	126
Output per head	91	115	100	120

I suggest that these figures show that comparing 1937 in the U.S. with 1935 in the U.K. affords a much truer basis of comparison than having 1935 in both cases.

In paras. (27) and (32) Dr. Snow mentions that "though each Census was announced as relating to the output of the year 1935, in the case of U.K. firms figures for 'financial years' ending at any time between April 7th, 1935, and April 8th, 1936, were accepted. Smaller latitude was permitted in the U.S. investigation." This, I feel, is an extremely small point. After reading Dr. Snow's comment, I have an idea that this factor rather worked in the direction of correcting the latitude between U.K. 1935 and U.S. 1937 by a fraction of three months, as far as British firms used the April 1935–March 1936 (British fiscal year) basis instead of the calendar year of 1935.*

(2) *Conversion of different types into one product*

In para. (14) Dr. Snow deals with my method of converting the different products of the same industry (such as different types of pig iron, different types of footwear or motor-cars) into one homogeneous product. I used, broadly, two methods. As I stated in my article: "Where the trade to be compared produced more than one commodity (say coke or gas) or different types of the same commodity (shoes for men and women), they were converted into one homogeneous product, *either* on the basis of physical weights (as in the case of steel products or tobacco products) or on the basis of their relative values (as in the case of different kinds of shoes or motor-cars)." Dr. Snow fails to mention that I used two methods, and disregarding my first method, he criticizes my second. He agrees that there is no other basis of conversion available in the Census statistics, but he thinks that "the proper factor to use for this weighting, if it were available, would clearly be some measure of the labour involved (*e.g.*, wages) in making each of the respective types."

This method of Dr. Snow is not the theoretically correct method. To the extent of relative wages costs being determined by relative productivities, by using his weights I really assume in advance that productivity in making mens-wear or womens-wear is the same, a proposition the validity of which I want to prove. Why, then, include other categories than mens-wear at all? By omitting the others and using his method the results would remain the same.

* For the leather trade Dr. Snow gives the relevant business years. I calculated that the difference in the volume of production in the two cases: (a) Assuming that all firms gave data for 12 months ending December 31st, 1935, (b) assuming that all firms gave data for 12 months as indicated by Dr. Snow is extremely small. In case of (a) the index is 109, in case of (b) the index is 108.7.

I think that the theoretically correct method would be to use relative wages costs plus gross margins or (taking the nearest Census concept) relatively net outputs of different types as weights, using, moreover, identical weights for both countries, based on their relative net values and, if the results of the two sets differ, to take the difference between them.

I want to point out that my enquiry was undertaken more than a year ago. Since then we succeeded in improving this weighting method to a certain extent, also took other factors into account, and arrived at some revised results. These results will be published, I hope, sometime in the near future.

I was very glad to hear that Mr. Leak thought that using relative gross output values per unit as weights is a good substitute for relative net output values. Nobody would deny that by using this substitute some arbitrariness is involved.

There is, however, one factor which affects the degree of arbitrariness very strongly. If the relation of the different types of products within the same industry in two countries (or two districts) is fairly similar, the arbitrariness is minimized. If the relation is very different, the arbitrariness is maximized. This is a very important consideration, as in para. (17) Dr. Snow compares, using the gross value weighting method, physical output per head in the footwear-making industries in the different regions of Britain. He finds considerable differences in the six regions, and as "it is impossible for anybody with detailed knowledge of the industry to accept this result as having any realistic meaning," comes to the conclusion that this proves that this particular method of weighting is wrong.

What happened is this: comparing British and American footwear trades, the internal structure of the trades is similar; roughly one quarter of all shoes, etc., made is men's footwear in both countries, about 35 per cent. of all footwear is women's footwear in both countries, and only the proportion of children's footwear and the residue differs to a small extent. In other words, the arbitrariness of the method is minimized. Comparing different districts of Britain, you find—at least on the basis of the 1935 Census—that one district, Northamptonshire, produces almost exclusively men's wear, other districts (Leicester, Norwich) almost exclusively women's and children's shoes. In other words, any arbitrariness which might be involved in the gross value weighting method is maximized in the geographical comparisons. The detailed data were as follows:

Percentage of different types of boots and shoes in total boot and shoe production

(Measured in th. dz. prs.)

	Men's	Women's	Children's	Others	Total
Northamptonshire ...	82.5	11.0	3.8	2.7	100.0
Leicestershire ...	4.2	50.6	38.5	6.7	100.0
Norwich ...	0.5	64.4	24.2	10.9	100.0
London ...	1.9	45.4	35.1	17.6	100.0
Bristol ...	62.2	22.2	15.6	—	100.0
Other areas ...	7.7	31.8	19.4	41.1	100.0
Total U.K. 1935 ...	23.4	35.4	23.0	18.2	100.0
U.S. 1937 ...	24.5	35.5	15.7	24.3	100.0

Source: Final Report of the Fifth Census of Production, 1935, Part I, p. 442, and the American Census of Manufacturers, 1939, Vol. II, Part II, p. 50.

In any case, Dr. Snow's argument that *because* with my method there appear differences in productivity between different areas in Britain, this proves that my method is unsatisfactory, can hardly be accepted. In the United States the situation in the shoe industry (with respect to the hire of machinery, etc.) is similar to that in Britain. Yet an enquiry undertaken by the Bureau of Labor has shown wide variations of labour productivity in 23 plants specializing

in the manufacture of men's shoes. The number of pairs of men's shoes produced per man hour varied in 1935 from 0.571 pairs to 2.653 pairs. The report points out that these variations are mainly due to the fact that the plants studied specialize in the manufacture of different grades of men's shoes. But even dividing the 23 plants into three quality groups, the variation within two subgroups is higher than those discovered by Dr. Snow for the British industry as a whole. The same American enquiry found that in case of plants specializing in the production of women's shoes the variations in labour productivity are similarly very great. In the 15 sample plants the number of pairs of women's shoes produced per man hour varied in 1935 from 0.363 to 1.118. (U.S. Dept. of Labor, Bureau of Labor Statistics, *Handbook of Labor Statistics*, 1941 edition, Vol. I, pp. 779 ff.)

(3) *Determination of number of workpeople associated with particular physical output*

This question is dealt with by Dr. Snow in para. (15), in para. (16), and then again in para. (28). The latter two deal with difficulties of industrial grouping. The problem of differences in the enumeration of workpeople (e.g., those engaged in transport) mentioned in para. (29) and para. (32) deals really with a related problem.

(a) There is no difference between Dr. Snow and myself that, taking any one product, the same manufacturing processes should be compared, and only those operatives taken into account who are engaged in the manufacturing process of the chosen product. The difficulties arising from the use of Census data are—at least on that account—purely statistical. One type of difficulty is that the industry is producing by-products or does repair work, etc.; in other words, the gross value of the trade is greater than the gross value of the chosen product. I dealt with this problem in the usual way, as I explain in my article: "In order to arrive at the number of operatives employed in producing the volume of output compared, it was necessary to exclude operatives producing by-products not included in the comparisons or those doing repair work, etc. In many cases this was possible only by assuming that the net output per head within the same industry was the same irrespective of whether the operative was engaged in producing the main product, or the by-product or was engaged in doing repair work." As I indicate the method I followed, and even its limitations, I am surprised to read para. (15) in Dr. Snow's paper, which implies that I related to a varying percentage of gross value always 100 per cent. of operatives.

(b) Another difficulty which is mentioned in para. (16) by Dr. Snow is that some small part of the output might be produced by other trades, which is included in the output, but may not appear in the number of operatives. This factor is automatically corrected by the procedure described in the previous para. That is, the gross value of the product is increased on that account, and thus the ratio of this gross value to total gross value, by which the number of operatives is reduced, has also increased. (In any case, Dr. Snow is wrong in supposing that this factor, had it been valid, would have made the comparison less favourable to the U.S. It makes it more favourable.)

(c) The simple procedure described above can be used only, of course, in cases where the value of the product is a very high proportion of the total gross value (to which the number of operatives corresponds). Owing to differences of classification, it happens that some trades are separate groups in the U.S., such as motor-cycles, bicycles and cars (i.e., all data are separately enumerated for all three groups), while in Britain they are three sub-groups of one bigger group. That means that certain data (e.g., number of operatives or wages, but *not* data on net output as Dr. Snow incorrectly states) are available only for the whole group, but not for the sub-group. Taking the motor industry as an example, motor vehicles represented only 60 per cent. of the gross value of output, and it is obvious that the simple method of reducing the number of total operatives to 60 per cent. would be entirely arbitrary. I therefore used another

very straightforward procedure. As the total number of employees for the sub-groups is given, and the ratio of operatives to total employees in the group is known, I assumed that this ratio holds good for the sub-groups, and reduced the number of employees for the sub-groups accordingly, to arrive at the operatives.

May I refer here to the query of Mr. Leak, as regards my method in comparing productivity in motor-car trades of the two countries? In both cases I confined my comparison to the operatives of firms engaged on assembly work only. For the United States the 1937 Census divides the motor-car trade into three separate parts: (1) Motor vehicles, (2) Motor vehicle bodies and motor vehicle parts, (3) motor cycles, bicycles and parts. I have taken into consideration only the first trade—motor vehicles.

Similarly in the British Census, making use of Table IV (Subdivisions of the industry) of the Motor and Cycle Trade, I used data referring only to the manufacture of complete motor vehicles, chassis, etc., and disregarded that part of the industry engaged in the manufacture of parts and accessories of motor cars, motor cycles and cycles. All necessary data for this subdivision are available in the published Census reports, except the number of operatives. This, however, can be estimated—as explained above—from the number of employees, assuming that the ratio of operatives to total employees as ascertained for the whole group also holds for the single sub-groups. For both countries I considered the following principal products for sale of these sub-groups:

- Complete motor cars
 - Private cars and taxi-cabs
 - Commercial vehicles

- Complete chassis
 - For private cars
 - For commercial vehicles

- Residue group—extremely small in both cases—for one country (U.K.); it includes motor cycles; for the other a mixed collection of cars (such as ambulances, etc.). Whether this group is excluded—in the usual way—or not hardly affects the calculations.

In both cases the number of personal cars is overwhelming, and the ratio of private cars to commercial vehicles similar (about 86 per cent. private cars and 14 per cent. commercial vehicles). Chassis are more important as a part of total production in Britain. My next step was to convert the different products into a homogeneous unit by the method of relative values. Then I reduced the number of operatives according to the gross value covered by my products, and compared the indices.

(d) In para. (29) and in para. (32) (i), Dr. Snow refers to the fact that “the method of calculating the number of workpeople in an industry differs in the two countries by the inclusion in the case of the United Kingdom of employees engaged upon the delivery and transport of goods where those operations are carried out by the employees of the manufacturing firms.” Though Dr. Snow mentions employees, I assume he means operatives, as this only is relevant for my purposes.

Operatives in the British Census are defined as “covering all wage-earners (including foremen, van and lorry drivers and warehousemen) employed in or about the factory or works, or in outside work of construction or repair.” The definition of the 1937 American Census reads, “all time and piece workers employed, including power plant and maintenance, shipping, warehousing and other departments. Working foremen and gang and straw bosses are treated as wage-earners.” The two definitions, on consideration, do not suggest incomparability, but I agree that further investigation of this point is very much worth while.* I do not expect that it will have much effect on the comparisons

* The relevance of this factor depends on the interpretation of “shipping” in the American Census. The shipping department of the American factories is responsible for packing, conveyance to transport means, etc., and probably also for transport itself, as far as it is part of the activities of the trade.

either way; moreover, the effect of this factor would be confined to industries where transport is of importance compared with the manufacturing activities of the trade.

(4) *Effect of short-time working*

In the second part of para. (15), in para. (30) and in para. (32), Dr. Snow suggests that the Census reports, "though providing figures of the number of people employed, say nothing about the time they are occupied. The practice regarding short time in the two countries is not the same." Dr. Snow goes on to suggest that "short-time working is much less prevalent (in the U.S.) than in this country"; he also suggests that this short time can be calculated only for Britain, and after making this calculation he comes to the conclusion that on that account U.K. output per operative in the footwear trade ought to be increased by 5 per cent. Dr. Snow apparently does not notice that by giving up the per man comparison, and accepting—what I believe is more relevant—the output per man-hour concept, he will get not an increase, but a great decrease in British productivity, owing to the average shorter hours worked in the U.S. But let us deal first with the statistical argument. In both countries, though the Censuses do not give information on hours worked (whether normal, average short hours or overtime), corresponding statistics collected by the British Ministry of Labour and the American Bureau of Labor give comparative information on average hours actually worked. In both cases short hours are already taken into account (at least to a very considerable extent), and thus they provide a basis to adjust my "per man" comparisons to "per manhour" comparisons. Unfortunately I have not been able to look up the average hours worked in the boot and shoe trades in U.S. for 1937, but for leather trades (which includes boots and shoes) the figure is 38.8 hours, for boots and shoes it is probably lower. According to the Ministry of Labour earnings and hours of labour enquiry, average hours worked in the week ended October 12th, 1935, in the boot, shoe and slipper manufacture trade was 47.2. In other words, the American productivity—on account of differences in man-hours worked—is understated by over 20 per cent.

(5) *Appropriate rate of exchange for comparison of values*

As my comparison is based mainly on physical quantities, and net output comparisons have only a secondary importance, added in order to supplement the evidence, the choice of rate of exchange cannot affect the reliability of estimates. The main reasons why I tried the method of physical comparison—in spite of the many pitfalls—was precisely this difficulty of finding the appropriate rate of exchange. I never thought for a moment that the market rate of exchange is the relevant rate for all groups of industry, on the contrary, I stated most emphatically in the footnote that "it must be emphasized that the conversion rates were chosen to correspond to relative purchasing power in terms of commodities in general, and not (or not necessarily) in terms of the products of the individual industrial groups. To the extent the purchasing power parity in terms of these individual groups would yield different results, the figures in the above table must be considered arbitrary." Dr. Snow seems to have overlooked this footnote. However, he made an important contribution by calculating the purchasing power rate for the leather trade, which, as I gather, is set out in detail in the coming Appendix.

I also want to mention that the question of the appropriate purchasing power rate received careful consideration, and the choice of the market rate was not indicated only by the fact that "it was easily available." In a footnote on p. 43 of my article I drew attention to a comparison of industrial production undertaken by the German Institute of Business Research in 1939. This comparison apparently tried to calculate purchasing parity rates for the £—Rm. and \$—Rm. relations, which yielded a purchasing power rate (a cross rate) of \$4.68 to the £, that is, a rate below the market rate. Although the German Institute gave no

details of how this rate was arrived at, this investigation gave support to the view that the use of the official rate would not over-estimate the industrial purchasing power of the dollar in terms of the pound.

(6) *The quality factor*

In para. (34) Dr. Snow says that I "assumed that industrial efficiency was measured by production per head—both by physical output per head and by value of output per head." I did not make any such assumptions. The terminology I used was "comparison of industrial efficiency, *based on physical output per head*" or industrial efficiency *as measured by production per head*. I suppose this is a careful enough formulation for readers of a learned Journal. The problem: what is the ultimate measure of industrial efficiency, is such a complicated one that it cannot be discussed in any detail on this occasion. But Dr. Snow brings in this context the quality factor, saying "such a view (leaving vague whether he means my view or Sir George Schuster's) appears to me to concentrate attention only on the quantum of production, and to ignore altogether the quality factor." I stated very clearly in my paper that "for obvious reasons there was no possibility of making allowances for qualitative differences (thus a standard American motor-car was regarded as equivalent to a standard British or German motor-car)." I feel, however, that Dr. Snow interprets the quality factor in a way which emphasizes the less relevant aspect and omits the important one. He suggests that "if we are trying to discover an index of efficiency, we must be careful to avoid adopting one which can equally well be applied as an index of shoddiness." It is left, then, for the reader to make up his mind whether the footwear and motor-cars mentioned a few sentences before are cases in point, or whether the argument is only to be taken in general terms. If Dr. Snow intends to argue that there is a general qualitative superiority of British over American products, I think he ignores the fact that for the vast majority of basic commodities, such as iron and steel products, cement, coal and coke, etc., there could hardly be differences of the sort he had in mind. Not shoddiness, but small qualitative differences (such as differences in counts in cotton), might of course be of some importance.

If we want to consider the quality factor, especially as a function of mass production—which is Dr. Snow's point—the important thing is not differences in quality (shoddiness), but differentiation in qualities. The fact that American industry is more standardized, that within each industry the range of products produced is vastly lower than in this country, is a fact of fundamental importance. All the technical information I received (subsequent to the writing of my article) points to the fact that the American industry has on that account a great technical advantage. This factor operates both as regards final products and also as regards components.

(7) *General comparability of two Censuses*

A considerable part of Dr. Snow's paper is taken up by examining the comparability of the two Censuses. Apart from the points I discussed already (period of returns, classification of industries, effect of short-time working), he deals mainly with three points :

- (a) Comparability of gross output and related concepts.
- (b) Importance of small firms.
- (c) Inaccuracies of returns.

The first set of arguments, relating to gross output, is almost entirely irrelevant as far as my present paper goes. The reading of Dr. Snow's paper may, however, leave the impression that in comparing scale or structure or productivity or, indeed, in any other aspects, I used the gross output concept. This is not the case. For the sake of completeness, the value of total gross output is given in Table I in money terms and in Table III in index form. In no argument or calculation in comparing scale or structure or productivity was the concept of

gross output used. Thus I measured scale of manufacturing mainly in terms of manpower, and additionally in net output. I did the same for the structure of production, and used the same concepts for dealing with productivity.

While criticizing comparability of gross output, Dr. Snow never mentioned the usefulness (or if he likes, the usefulness in spite of some shortcomings) of net output as a basis of comparison, although it is the obvious instrument to use for dealing with such problems as my article covered.

By measuring the scale of manufacturing in terms of manpower, the number employed in small firms was obviously taken into account.

I do not feel that the productivity comparisons (as distinct from comparing total scale of manufacturing operations) are biased in any way by the exclusion of small firms, especially as a very high proportion of these firms is engaged in repair work. Their exclusion, however, if anything, is a bias in favour of the United Kingdom, as the value of net output per head is lower in the small firms (vide Final Report, Part V, of the 1930 Census) than in the other size categories, and there is every reason to believe that in such trades as boots and shoes or motor-cars physical productivity is also lower.

As for the comparative inaccuracies of returns, this is a point which, if taken seriously, would make it impossible to collect any comparative national or international statistics. Most of Dr. Snow's arguments on the incomparability of British and American censuses are of a type which can be applied (and if we want, supplemented *ad infinitum* with further arguments) to prove that subsequent British Censuses are incomparable or any other two sets of British statistics are incomparable. I suggest that all these qualifications relating to general comparisons of economic statistics should be properly weighted instead of the qualifications being ignored or (as Dr. Snow suggests) the statistics ignored because of the qualifications; at the same time I wholeheartedly support Dr. Snow in urging the collection of more comparable statistics.

(8) *Need for specialist knowledge of industries investigated*

There is one point on which I fully agree with Dr. Snow, and this is the need for specialist knowledge of industries to check and elaborate my calculations. I never regarded my figures as anything but provisional estimates; I tried to make as many qualifications as I thought necessary—no doubt further qualifications might be added; others are so obvious that I have not stated them. I did not comment on causes, as my evidence was not yet sufficient, and the conclusions were carefully worded. My conclusion that industrial efficiency, as measured in production per head, was roughly similar in Great Britain and Germany, while in the United States it was more than twice as great as in the two other countries is overwhelmingly supported by the material published in the *Economic Journal*, and otherwise at my disposal. I do not think that any of the qualifications which might be added on account of Dr. Snow's comments, weakens this conclusion. I readily agree, however, that much further work has to be done on details, and that is where the help of technicians comes in. In my further researches on the subject I have already received considerable help, but I am glad to say that directly or indirectly my article seems to have stimulated independent research on the subject by experts with the necessary technical knowledge.

The Cotton Board, in its Trade Letter of December 14th, 1943, publishes an article on output statistics for Britain and U.S.A. After making the necessary qualifications, the Cotton Board estimates that in 1937 "within the limits of official statistics, productivity per operative hour in the United States [not integrated] spinning industry is probably slightly higher than in the United Kingdom industry, but not by more than 10 per cent." In the integrated cotton trade of the United States "the output of cloth per operative hour is probably twice as great as in the United Kingdom." This calculation already takes into account differences in average working hours on the one side, and (in the spinning section) the higher counts in favour of the United Kingdom. The results in

the spinning section are not dissimilar from mine, but in the weaving section I apparently under-estimated the American advantage. The same article gives most relevant information on the different organization of the respective industries in the two countries (integration).

As for the Iron and Steel Trades, Sir William Larke, Director of the British Iron and Steel Federation, accepted my rough estimates (Vide *The Times*, December 1st, 1943.) Other independent estimates, using much more technical knowledge and experience than I commanded, also largely corroborated my evidence.

I hope that more similar investigations by people with technical knowledge will be forthcoming. No doubt Dr. Snow's paper will serve as a stimulus, and I congratulate him on the important contribution which he made in regard to footwear industries.

The following contributions were received in writing:—

MR. ROY GLENDAY, who regretted that he was unable to stay for the whole of the discussion, wished to be associated with Dr. Snow in doubting whether international comparisons of output per head served much useful purpose, unless accompanied by detailed information about the environment of the industries that were being compared. The ordinary man in the street was apt to treat such comparisons in much the same way as at school he treated arithmetic problems of the kind that enquired how long it would take three men to fill a tank when A worked twice as fast as B and B three times as fast as C. A was taken to typify the most efficient and up-to-date worker, while poor little C was the weakling and inefficient member of the party. But comparisons of the relative efficiencies of different industries in different countries involved problems of a different order. Alfred Marshall had many years ago drawn the fruitful distinction between the internal economies which a particular firm was able to secure as the growth of the market permitted it to enlarge the scale of its operations, and the economies external to the individual firm which showed themselves in changes either in the organization of the industry as a whole or in the environment in which it operated. Over the years a firm might be progressively increasing its output, but its changes in method and organization might be kept within circumscribed bounds, for the degree to which an individual firm could make its operations more "roundabout" was limited. Meantime, in the outside, wider industrial field innovations might emerge destined in due time to precipitate "discontinuous" revolutions in industrial method and organization generally. No useful practical purpose would appear to be served by instituting comparisons between output per head in the industries affected before and after such discontinuous revolutionary change; for such comparisons would relate to different levels of organization. This applied in particular to comparisons of output per head made between countries at different levels on the ladder of economic evolution. Discontinuous innovation might take the form of the adoption of a new system of "rotation" in the case of agriculture, and in the industrial field of such things as the building of a railway where none existed before, the substitution of factory production for hand production or of mass-production for simple factory production.

Adam Smith when he had enunciated his famous theorem that the division of labour depended on the extent of the market was in the main thinking of the effect of the division of labour in stimulating the *individual* to invent new methods of carrying out routine occupations. He overlooked what we now regard as its most important feature, namely, that with the division of labour a *group* of complex processes was transformed into a succession of simpler processes, some of which could be made continuous in time by the use of machinery. But—and this was an important limiting factor—the extent to which it would pay to do this would depend on the extent of the market. As Professor Allyn Young pointed out many years ago in an illuminating article in the *Economic Journal*, "It would be wasteful to make a hammer to drive a single nail." * "Equally,

* December, 1928.

Mr. Ford's methods would be absurdly uneconomical if his output were very small, and would be unprofitable even if his output were what many manufacturers of motor cars would call large." This point was apt to be overlooked by those who referred to economies of large-scale operations or "mass-production" as something which could be had for the asking by what was termed a more "rational" organization of industry. The deciding factor would, of course, be the absorbability of the market, which must be sufficient to make economical that which would be uneconomical if the benefits could not be diffused over a large final product. Referring to this problem, Professor Allyn Young, who, it was useful to remember, was an American, wrote in 1928, "I have naturally been interested in British opinions respecting the reasons for the relatively high productivity (per labourer or per hour of labour) of representative American industries. The error of those who suggest that the explanation is to be found in the relatively high wages which prevail in America is not that they confuse cause and effect, but that they hold that what are really only two aspects of a single situation are; the one cause and the other effect. Those who hold that American industry is managed better, that its leaders study its problems more intelligently and plan more courageously and more wisely can cite no facts in support of their opinion save the differences in the results achieved. Allowing for the circumstance that British industry, as a whole, has proved to be rather badly adjusted to the new post-war economic situation, I know of no facts which prove or even indicate that British industry, seen against the background of its own problems and its own possibilities, is less efficiently organized or less ably directed than American industry or the industry of any other country."

Mr. Glenday remembered a representative of the American General Motors Corporation observing some years before the present war that although German wages were far below American wages, their German subsidiary had been unable to produce cars as cheaply in Germany as in America because the German market was not large enough to make it worth while to mass-produce parts and accessories.

Another aspect of the same matter was that the size of a market must be measured not by area or population alone, but by buying power—the capacity to absorb a growing annual output of goods. This was something which might be governed by factors quite different from and external to those controlling the rate of expansion on the production side in the industry seeking to dispose of its goods. For example, the speed of sale of motor-cars in a given country depended amongst other things on the rapidity with which such things as motor-roads, garages and hire-purchase facilities could be provided, matters over which the motor-car manufacturer would usually have little direct influence.

For the above reasons it could not be taken for granted, as was commonly done, that better management and a greater expenditure on industrial research could be relied on to effect as large reductions in what economists call "the average real costs per physical unit of production" in Britain as in the U.S.A. Moreover, it was doubtful whether even the latter country could in future continue to go ahead as rapidly as in the past. Quite apart from the fact that improvements in mechanical efficiency had in recent times been used much more to reduce hours of work than to expand output, the maintenance of increasing returns appeared nowadays to require in many directions an acceleration in absorption of output beyond anything even the modern market could cope with. This condition was apparently reached in a number of U.S. industries at the close of the 'twenties.

Recent statistical studies of various industries in Great Britain and the United States suggested that over the past hundred years there had been, in fact, a connection between the growth, not of the individual firm, but of the industry and the rate of reduction in real costs.* If this were true, then unless the rate of absorption of output could be continuously increased the manufacturing nations

* See Colin Clark, *The Conditions of Economic Progress*, Chap. VIII, and G. I. Jones, *Increasing Returns*, pp. 250–254.

could not look forward confidently to the maintenance for an indefinite time of the increasing returns to which they had become accustomed. The evidence suggested that an increase during the next hundred years or so in the per capita output at as rapid a rate as that to which our ancestors were accustomed was as unlikely as was an increase in Western populations at the nineteenth-century rate.

SIR GEORGE SCHUSTER, M.P., who was detained in the House of Commons, expressed regret at his inability to attend and offered the following comments: I have read Dr. Snow's paper with immense interest, and feel that he has rendered a great public service in his analysis of the data for efficiency comparisons and in his emphasis on the vital importance of "mastering the facts." I hope he will also agree that Dr. Rostas rendered valuable service in his original article. Speaking for myself, I fully appreciated all Dr. Rostas's reservations; but the shortening of my articles in the course of editing by *The Times* altered the emphasis of what I had said. My own main purpose, however, was to call attention to this kind of *prima facie* evidence, and wake certain people up to the general question of the equipment of British industry—a matter which I consider to be of vital importance.

Of course Dr. Snow is right in calling attention to the *quality* factor, but that in itself is a matter which deserves investigation. In considering industrial products as industrial products the importance of quality has to be judged in relation to the purpose which the product has to serve. Length of life is not necessarily an absolute criterion of merit. For example, in the case of a motor-car or a machine tool which is liable to become obsolete, longevity has not necessarily the same value as in a pair of boots which need not fear obsolescence and, indeed, acquire comfort and earn affectionate esteem as each year passes.

This does not weaken Dr. Snow's argument, but it does suggest other questions which may be of economic importance, *e.g.*, whether British methods do not sometimes spend energy, quality, or accuracy in directions which do not really repay the effort.

Turning, however, to the main point of the comparisons, I still would put forward the following as an appreciation for which a strong *prima facie* can be made out:

That over a wide range of production American industry, after paying its labour at a very much higher rate than prevails in the corresponding British industry, can turn out products at cheaper prices and of a quality which suits the purchaser as well as or better than the British. This indicates that a large proportion of American industry works with better mechanical equipment and a better lay-out—in fact, that the American worker is given better tools with which to work and therefore can earn more money.

All sorts of factors have contributed to this result—the British taxation system, the differences in regard to shift-working, etc. The last may be a very important factor, since obviously an industry which works its equipment for three eight-hour shifts can afford to have more capital locked up in it than one which only works for one short shift.

It seems to me that there are a great number of factors in industrial efficiency in regard to which accurate comparisons ought to be made between this and other countries, and if Dr. Snow or other members of the Statistical Society could start examinations of these matters they would earn the gratitude of many people—and first, of myself.

MR. T. BARNA: I should like to add to Dr. Snow's paper that, in comparing the censuses of production of two countries there seem to be two main difficulties, apart from difficulties due to divergences in administrative practice.

- (i) For any industry data relating to quantities (as distinct from values) are incomplete.
- (ii) Goods called by the same name can differ in quality.

The first difficulty is solved by either of two assumptions. Each industry is divided into two parts; for the first part, data for quantities are available (and consequently data for average prices); for the second part, values only are available. It is usually assumed that the results obtained for the first part of the industry are applicable to the whole. It can be assumed that *either* the quantity index *or* the price index obtained is applicable.

In comparing the increase in production in Britain between 1930 and 1935 these alternative assumptions are associated with the names of Dr. Rhodes and Mr. Devons respectively.* But, in spite of the controversy, there was little difference in the indices calculated for the period by either of the two assumptions.

This is, however, not necessarily the case when international comparisons are made and, I would suggest, that in such a case the second assumption (that of Mr. Devons) seems to be preferable. If an industry produces certain specified products and "other products," it is more likely that the prices of "other products" are in both countries proportional to the prices of specified products than that the quantity of "other products" is proportional to the quantities of specified products.

Dr. Rostas adopted the first assumption. If the second assumption is applied to the wireless industry, for instance, it is found for 1935 that productivity per head in the U.S. was 200-250, according to the system of weighting, and denoting productivity in the U.K. by 100.†

I would also suggest that more light could be thrown on the problem of quality if the approach is made through comparing prices instead of quantities. The price index, after allowing for market imperfections, must be within reasonable limits in comparison to the rate of exchange.

Taking the index of productivity and net output per head in both countries for the motor-car industry, as quoted by Dr. Snow, a rate of exchange of \$2.42 to the £ is implied as against the market rate of \$4.90 in 1935.

Some of the difficulties could, perhaps, be overcome by comparing the prices of British and American goods in markets where they compete, possibly in a third country.

I should add that this criticism does not deny the validity of the indices of productivity calculated for industry as a whole, but throws some doubt on indices for various industries which are widely different from the average index, unless there are corresponding differences in net output per head.

MR. MAIZELS and MR. FRIDAY: We feel that not only should the general conclusion of greater productivity per head in the United States be accepted, but that more attention should be given to the factors underlying this marked difference if the United Kingdom is to increase its manufacturing productivity after the war. There can be no question that the main factors contributing to the rise in the standard of living throughout all civilized countries have been the greater use of fixed capital per operative, the improved techniques and increased labour-skill which went with this development, and improved methods of organization. Here we intend to discuss only the first of these factors, as it is of basic importance in any comparison of industrial efficiency. Far more attention should be paid in industrial statistics to actual factory equipment: its quantity, quality, utilization, power, etc. The following comments are made in the hope that the importance of such statistics will be more fully recognized in the future:

1. *Degree of Mechanization.*

This can be measured in two ways:

(a) Where machines are homogeneous and easily comparable it is possible to compare the number of machines per operative or the pro-

* Cf. A. L. Bowley, *Studies in National Income*, pp. 144-145.

† Part of the difference between this figure and that of Dr. Rostas is due to taking here 1935 data for both countries.

portion of output produced by certain types of machines; *e.g.*, in the coal-mining industry in Great Britain the percentage of total output cut by coal-cutting machines in 1936 was 55 per cent., whereas in the bituminous coal industry of the United States the corresponding proportion for that year was 85 per cent. It is true that the coal strata in the United States are more suitable on the whole for exploitation by mechanical coal-cutters than are those in this country, but the extension during war-time of mechanical aids to production in the coal-mining industry of Great Britain reveals the extent to which this industry was under-mechanized before the war. Similar statistics would be of great value for the factory trades, *e.g.*, the number of spindles or number of looms per weaver.

(b) A general indication of the extent to which American manufacturing industry has a higher mechanization per head than British can be shown by using figures of the power of equipment installed (or in use) as referred to by Mr. Leak.

2. Degree of Utilization of Machinery.

An indication of this is provided by the Census of Production figures showing the proportion of power equipment idle in 1930 in this country. In that year 20 per cent. of the capacity of prime movers and 11 per cent. of that of electric generators driven by purchased electricity were recorded as being in reserve or idle in the factory trades. There are no comparable figures for the United States for any year prior to 1939, but the Census of Manufactures for that year shows that there were then just under 10 per cent. of the total capacity of prime movers and electric generators "ordinarily idle."

Apart from the indication shown by power equipment, it would be very useful to know also the proportion of each type of machinery which was actually in use at a given time in each of the principal industries of different countries.

3. Age of Machinery.

Another explanation for differing *per capita* output figures can be found from a life table of machinery in the industries of the two countries. There is little information on this subject, but in the *Economic Journal* of December 1930, Mr. John Ryan gave some information obtained from an important sample in the cotton trade. It is interesting to note that for opening machinery then in existence, 22 per cent. was past the recognized standard of efficiency of life; for carding machines the proportion was 31 per cent.; for draw frames 35 per cent.; and for speed frames 40 per cent. These are high percentages of out-of-date machinery, and though the cotton industry may be an exceptional case, similar information for certain other industries in both the United States and here may well be equally enlightening.

4. Size Structure of Firms in Industry.

Higher costs in the United Kingdom are often excused on the ground that the United States manufacturers have a bigger market, and can therefore operate with lower overheads. It is doubtful whether this argument can in all cases be considered valid, because the question is clearly one of the optimum size of a firm, and it could happen that for comparable industries the number of firms could be correspondingly smaller in the United Kingdom, but of the same average size, though manufacturing units may be larger for industry as a whole. Moreover, the home market is not the limiting factor, and in considering this question the size of the export market must also be taken into account. Much of this information is already available in the Censuses of Production and would repay study from this point of view. For the tobacco industry, for example, the average size of establishment in the United Kingdom in 1935 was 364 persons, while for the United States in 1937 the figure was only 116 persons (excluding distributive staff attached to the factory), yet Dr. Rostas found that physical output per head in this industry was 171 for that country in 1937 compared with 100 for United Kingdom in 1935.

It is unfortunate that there are so few statistics available regarding factory equipment, and if the information cannot be collected on a large scale there is certainly scope here for sampling studies. The differences in productivity between the two countries are too large to be dismissed as the mere consequences of statistical incomparables, and the time has surely come when some really useful research work could be done into the causes of these differences.

MR. R. G. FORRESTER: I should like to raise two points in relation to the Society's Memorandum on Official Statistics.

Its compilation was the work of a special Committee appointed by the Council. That Committee was composed largely of the "guttering volcanoes", to which Mr. Leak referred, and of near guttering; it did not include, nor did it draw upon for evidence, the greater part of the Society's Fellowship—those rank and file statisticians who are doing the basic work in the compilation of official statistics. I do not wish to suggest that the virtue is all on the side of the young, nor to imply that crabbed age has no contribution to make to the discussion; it is clear that the experience of the elder statesmen must be a vital part of any discussions; but I would suggest that it was an unfortunate omission that the ideas and experiences of those junior Fellows who are in intimate contact with the actual work were not sought and embodied in the Memorandum. The President spoke of a forthcoming discussion with the Departments concerned on the suggestions put forward in the Memorandum. Would it be impossible or undesirable that the deputation that waits on their representatives should include one or two Fellows who have had a worm's-eye view of the Government statistical service?

As regards content, the Memorandum is built round the central principle that more information will be needed for "ministerial guidance." I feel that Sir George Paish put the position more clearly and correctly when he emphasized that we must be the supply train, the munitioners of democracy. I believe that not because, like Sir George, I think that no politician can tell the truth, but because the politician is more likely to tell the truth if he might be caught out by facts and figures. Furthermore, it is surely clear that no democracy can function effectively unless there exist the facts that provide the basis for informed criticism. Statistics, of production, of health, of trade, of national income and on hosts of other topics, are part of the background that must be provided. It is our responsibility to ensure that democracy is armed with the necessary facts.

I wish strongly to support the proposals for international contact to be built up. We should invite delegations of our colleagues in the United States and in the U.S.S.R. and China to exchange experience and create by personal touch an appreciation of one another's point of view. One of the most promising developments is embodied in the suggestion of the Hot Springs Conference that the permanent organisation envisaged should have as one of its functions the collection of statistical and economic data regarding food and agriculture. This is a practical proposal that we may well support, for if it is followed in other fields international contacts will inevitably result.

THE PRESIDENT, after expressing his appreciation of the remarks of the Proposer and Seconder of the Vote of Thanks and his agreement with Mr. Clay's estimation of the value of Dr. Rostas's paper, said that he would deal in detail with the points raised in a written reply. This is as follows:—

I have particularly to thank Mr. Leak for pointing out certain errors in the proof of the Paper, which have since been corrected. I agree with him that, for the purpose in hand, "weighting" by a factor representing only labour is far from ideal, and that if the data were available, a factor representing labour plus organization plus machinery would be much better. I had in mind, however, general practicability, and there is more likelihood of obtaining data representing labour alone than representing the other two items as well. "Net output" is, however, too comprehensive, as it includes other factors not

reflecting ability to produce efficiently, *e.g.*, rates, insurance, etc. The proportion of these in "net output" is very variable.

With regard to the information available in the Census of Production Report about the motor and cycle trade, I agree that the six sub-divisions of that industry may themselves be considered as "industries," but this does not help very much in trying to determine the correct number of persons responsible for the production of the stated number of cars, which information is necessary for the proper comparison of output of cars per person employed. In this country only about three out of every four employed by firms whose chief business was making motor vehicles were actually engaged in making these vehicles. In the United States the proportion was nine out of ten. This factor, however, can only account for a relatively small proportion of the difference in "output of cars per head" in the two countries.

I must confess that when writing this Address I had overlooked the important paper of Sir Alfred Flux in the *Quarterly Journal of Economics*. This oversight, however, enables me to take the opportunity of pointing out to others who may be working upon problems bearing upon Census of Production data the great benefit they may derive from consulting Mr. Leak and his colleagues at the Board of Trade about the material for their problems. The officials of the Statistical Department of the Board of Trade must necessarily be much more deeply immersed in those data by reason of daily contact than are those who approach the problems as amateurs. With their wide background of knowledge, the former can probably call to attention points which might escape non-official investigators.

In the paragraph referring to international co-operation of statisticians I was thinking mainly of non-official co-operation. I appreciate the great value of the work done by the organizations mentioned by Mr. Leak, including the League of Nations Economic Section, the International Institute of Agriculture and the International Labour Office. The international convention relating to economic statistics promoted by the League of Nations in 1928 was a most important movement towards the creation of statistical uniformity in import and export statistics.

Mr. Leak is to be congratulated on his post-war plans for obtaining additional information in the Census investigations, and particularly regarding the inclusion of figures of stocks of goods and material. The importance of the factor of stocks in relation to output differs very much with different industries, but in the case of some—*e.g.*, leather—the variation of stocks between one year's end and the next may be almost as important as the amount of business done in the year in determining the annual profits.

The question of the rate of exchange appropriate for making comparisons of the output of industry in two countries referred to by Mr. Clay seems to me to be a very difficult one. Market rates of exchange are determined in the main by transactions of many kinds which actually occur between the two countries. But these transactions represent only a very small proportion of the grand total of financial transactions with which either country is involved. I can see no reason why the market rate of exchange should be the correct one to apply to comparisons relating to an article in which there is never any contact between the two countries. For example, the amount paid for domestic water supply in the United States may be "*x*" dollars and the corresponding amount in the U.K. may be "*y*" pounds. I can see no meaning, however, in converting "*x*" dollars to sterling at the market rate of exchange with a view to trying to make a comparison between the cost of domestic water in the two countries. At the other extreme we may have an article in which both countries are entirely dependent on supplies from overseas—*e.g.*, jute. In this case, if the output per head of jute goods in the United States is represented by "*c*" dollars and that in the United Kingdom by "*d*" pounds, the conversion of "*c*" dollars into sterling at the commercial rate of exchange does enable a realistic comparison of output per head in the two countries to be made. In between these extremes we have all sorts of cases

in which the proportion of the transactions which have an international flavour varies. In some, in which the international proportion is large, the proper rate of exchange would seem to me to be relatively near to the market rate, but in others it might be well removed, and it seems necessary to consider each case on its merits and try to ascertain an appropriate figure.

I hope that there was really nothing in the Address which justifies Mr. Crowther's view that it was an invitation to complacency. The Paper was not intended to deal with the actual comparison of output in the United States and the United Kingdom, but merely with some of the tools for making such a comparison. I entirely agree that there is nothing which justifies industrialists in this country being complacent with regard to their production, but it is a mistake to assume that they are generally unaware of what their opposite numbers in other countries are doing. Interchange of industrialists is far more common than is generally comprehended. Most of it goes on unheralded by publicity. Far from it being the case that there is no effort by industrialists here to keep abreast of developments in other countries, in the industries with which I am acquainted an outstanding fact is the speed with which an advance in one country does get copied in others. But there may be some special reason for this, and I have no wish to generalize.

I am grateful to Mr. Glenday for the various quotations and illustrations indicating the doubtful character of some statistical indices (so far as data are at present available) as a basis of international comparison of industrial output. These indices are complex averages of the results from many firms, and without detailed analysis it is impossible to say whether the comparison is really of "like with like." The footwear industry of the United States caters for populations living in climates of great diversity, and the typical footwear in the far south is different from that in the north. The footwear industry of the United Kingdom caters for a population practically all of which falls under the influence of the Gulf Stream. The nature of the footwear and the output per head depend substantially on the population catered for. A much bigger output per head would be expected of the lighter type of footwear used in warmer climates than of the heavier types worn in more rigorous conditions. It is necessary, accordingly, to have some knowledge of the "break-up" of the indices. They cannot be accepted at their face values for comparative purposes. All we are really entitled to say (using the footwear illustration) is that the output of American footwear per head is "*n*" times the output of British footwear per head, and we are then left with the much more difficult problem of comparing "American" footwear in the mass (about 400,000,000 pairs per annum) with "British" footwear in the mass (about 120,000,000 pairs per annum).

I agree with Sir George Schuster that "there are a great number of factors in industrial efficiency in regard to which accurate comparisons ought to be made between this and other countries," but I doubt if this can be properly done on the basis of general statistical evidence alone. The data of the Census of Production can be only a starting point for investigations which must be carried on further by people with knowledge of the industries under investigation. It may be that there are certain industries for which the Census of Production results provide a fairly complete picture for comparisons. Most industries, however, are far too complex to be able to yield their secrets in such a simple manner.

In referring to Dr. Rostas's remarks, I should start with the general comment that in the main they relate to the actual comparison of industrial output in the United States and the United Kingdom. I tried to confine myself to comments on some of the tools available for such comparisons—a much less ambitious objective. As I have said above, I do not consider that the tools provided by the Census of Production reports do, in general, afford an adequate means of getting to the kernel of the problem, though they are very important as a starting point. The chief points of detail raised by Dr. Rostas were the following:—

(1) *Period used for comparison*

I think the type of investigation Dr. Rostas undertook would become very artificial if special attention were to be given to the selection of different years for comparison of output of the two countries by reference to the position of those years in the curve of industrial activity in the two cases. There would be so much scope for individual judgment in the selection of the years that the issue would become very confused. It is conceivable that we may ultimately obtain such refined data that we can with confidence say that the output for year "a" for one country is the appropriate figure to compare with the output for year "b" for the other. For the present, however, I have no doubt that the most reasonable comparison is to compare the output of the same year in the two cases, pointing out, if necessary, those features in which one year may be considered more or less favourable to the one country than to the other.

(2) *Conversion of different types into one product*

I have referred, in my reply to Mr. Leak's remarks, to the question of the proper weighting factor to be used in this section of the investigation. If a really satisfactory system of weighting could be determined, it does not seem to me to matter whether "the relation of the different types of products within the same industry in two countries (or two districts) is fairly similar" or not. The scope of such enquiries as those of Dr. Rostas would be very much restricted and their results of little use if they had to be confined to cases where "the relation of the different types of products within the same industry in the two countries is fairly similar." Even if there is similarity in proportion of types within an industry in the two countries, there may be great dissimilarity in the make-up of the constituents in the types. The fact that the proportions of footwear described as women's and men's in the United States and the United Kingdom are approximately the same in the two countries does not by any means demonstrate that the products themselves are comparable. There may be considerable difference in the nature of the production within the type. Although in the huge output of the United States there are naturally many women's shoes of types suitable for this country, the fact that over a large part of the States it is universal to wear rubber overshoes in the winter means that the proportion of the sub-types within the type (e.g., light, medium, heavy, etc.) differ substantially. Whether the footwear produced is "light" or "heavy" has distinct bearing upon the "output per head," and we really require knowledge of this character before we can draw reliable conclusions.

(3) *Determination of number of workpeople associated with particular physical output*

The assumption that "the net output per head within the same industry was the same irrespective of whether the operative was engaged in producing the main product or the by-product or was engaged in doing repair work," which is the basis of Dr. Rostas's method of overcoming the deficiencies of the data in this problem, is not satisfactory. I gave an example of this in paragraph (28) and it can be further illustrated by the fact that the 1935 United Kingdom returns showed that the net output of persons employed in footwear repairing was 25 per cent. above that in footwear manufacturing. (The sample of the repairing firms, moreover, was a very deficient one, and did not include the thousands of small firms in which the net output per head is greater than in the large factory repair establishments. Small establishments frequently appear to have a greater net output per head than the average establishment. Footwear manufacturing firms employing fewer than 25 workpeople had in 1935 a net output of £197 per head, as compared with an average for the whole industry of £162 per head.) There is considerable variation in net output among different samples of an industry. For the geographical samples for the footwear repairing and manufacturing industries taken together, the net output

per head in 1935 varied from £186 to £124. The distribution of net output among individual workers or relatively small groups of workers must be a very wide one, and the chances that the output of a small group of individuals approximates to the average of all cannot be very great.

(4) The data from the Bureau of Labour Statistics referred to by Dr. Rostas provide evidence for the point I tried to make rather than controvert it. That point is that there is much variation in the output per head of individual firms, and the particular market for which the firm caters may be largely responsible for this. An illustration mentioned before may be referred to in this connection. A firm making footwear for use in the southern states of the United States, in which there is little difference between winter and summer conditions, makes a different type of footwear (with a different net output per head) from one making for a market in a climatically more rigorous section of that country. In this country the net output per head in making summer footwear is different from that in making winter footwear for the same population. In comparing averages for the two countries, therefore, we may fall into error. The distributions may be markedly different. I think we should find, if we had the data, that the net output per head of firms during the period they are making women's summer footwear in this country approximates more closely to the corresponding figure in the United States than does the average net output per head over all the industry in the two cases.

(5) My reference to net output in paragraph (28) should obviously have read "net output per head"—a figure which depends on knowledge of the number employed.

(6) The only point I would refer to in Dr. Rostas's long paragraph 3(d) is in the last sentence—the fact that road transport in the United States is of greater importance than here. I have seen no general figures enabling comparison to be made, and I should doubt if the statement were correct for the period 1935–37.

(7) Dr. Rostas's figures of average hours worked in the two countries, though not properly comparable, support the view that the comparison by number of people employed without regard to the time they are occupied in the employment is deficient. It does not matter whether this correction appears to "favour" one country or the other. The point is that without it the comparison may be misleading.

(8) My references in paragraphs (21) to (31) to the bases of comparison of the United States and the United Kingdom Censuses were not intended to have any reference to Dr. Rostas's work, and, indeed, that work was only mentioned once in those paragraphs—in a footnote to paragraph (28).

In comparison with the work likely to be done on the subject in future, it can be said that the problem of the international comparison of industrial output has so far hardly been approached. It is likely to become of such public interest over the next few years that we may expect a continuous output of the results of statistical investigations of the character of that of the Cotton Board (mentioned by Dr. Rostas in his contribution to the discussion). The ideal method of conducting these would be jointly by the statisticians of the individual industries of the United States and the United Kingdom, since only in this way could the detailed knowledge of the data of the industries be used to the best effect. In general this method will not be practicable; it is to be hoped, however, that the industrial associations concerned will develop interest in the problem and encourage investigations with a view to making comparisons of the output of their industry in this country with the corresponding output in the United States and other countries. The likelihood is that the results of the investigations will exhibit great variety. For some industries output per head in the United States may be much greater than in this country while for others it may be only slightly greater, and the discovery of the causes of this difference will in itself be important. Until some progress has been made in these directions it seems wise to be cautious in generalising about the superior productivity of labour in the United States.

As a result of the ballot taken during the Meeting, the candidates named below were unanimously elected Fellows of the Society:—

Nigel Marlin Balchin, Lt.-Col.
 Cecil Dudley Ballantine.
 T. Barna, B.Sc.
 Charles Edward Benham, A.I.A.
 Uri Bergman.
 Basil Martin Bird.
 Albert George Blakes.
 Stephen Bodington.
 Denis King Britton, B.Sc.
 Joseph Leonard Bull.
 Hugh McDonald Cessford.
 J. Clements.
 Winifred Margaret Corbett, Mrs.
 Robert Leslie Davies.
 Arthur Stanley Day.
 Alfred Herbert Dodd, M.A., F.I.C.
 Peter Derek Eeman, M.B., B.Ch.
 William Edward Egner.
 Moss Fairmont, D.Sc.
 Robert Arthur Finlay, A.I.A. +
 Henryk Frankel.
 André Gabor.
 Josef Goldmann, B.Sc.
 Alfred Herbert Roberts Grimsey, Captain.
 Ewa Grodzicka-Estreicher.
 Ludwik Grodzicki.
 Stanislaw Gryziewicz.
 Eugene L. Hamilton, Captain.
 Jack Haydock.
 Richard Edward Hills.
 Bishop C. Hunt.
 James Avery Joyce, B.Sc.
 David George Kendall.

Casper Alexander Kraay.
 Robert Edward Lawson.
 Conrad Emanuel Victor Lcsér.
 Bernard John Lewsley, B.Sc.
 Gordon Harrison Lockett.
 Probodh Chandra Mittra.
 Arthur John Havart Morrell, M.A.
 David Mowatt.
 Harold Neville Munro.
 Zygmunt Nawrocki.
 Dennis Newman.
 Henry Palca, B.A.
 Ivan Brian Perrott.
 Harold Radcliffe Philpot, Squadron-
 Leader.
 B. M. Pocock, B.Sc.
 Eric Cecil Raynold Reeve.
 Leon Rostas.
 Eric George Saunders.
 Eldred Hutchinson Sealy.
 Charles Henry Sharpston.
 Wilfred Smith.
 John Newton Stephens.
 Atul K. Sur.
 Charles Thomas Sutton.
 Brinley Thomas, M.A., Ph.D.
 Michael Tobias Vogel.
 Anthony Heriot Watson.
 Sydney John William Wells.
 Noel Alfred Dennis Willshire.
 Arthur Charles Wright.
 Wallace Wheldon Wright.
 Frederick Joseph Wurm.

Representatives of Corporate Bodies

George Ellis Flack, M.A., *representing* University College, Nottingham.
 Václav Kác, *representing the* Czechoslovak Ministry of Agriculture.
 Frank Thomas Scribens, *representing* Edmundson's Electricity Corporation, Limited.
 René Alexander Wiesner, *representing the* Czechoslovak Ministry of Public Works.

MISCELLANEA

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EXTENSION OF A THEOREM BY HARALD CRAMÉR ON THE FREQUENCY DISTRIBUTION OF THE QUOTIENT OF TWO VARIABLES

By R. C. GEARY

CRAMÉR (1937, p. 46) * has shown that if X_1 and X_2 are independent variables, with finite mean values and with characteristic functions $f_1(t)$ and $f_2(t)$, if X_2 can only assume positive values, and if the integral

$$\int_1^\infty \left| \frac{f_2(t)}{t} \right| dt$$

converges, then the frequency function of the quotient $x = X_1/X_2$ is given in a certain interval by

$$\phi(x) = \frac{1}{2\pi i} \int_{-\infty}^{\infty} f_1(t) f_2(-tx) dt,$$

provided that the integral is uniformly convergent in that interval. The object of this note is to determine formally the corresponding expression when X_1 and X_2 are not necessarily independent.

Let the joint frequency and characteristic functions be $F(X_1, X_2)$ and $f(s, t)$ respectively. Without loss of generality, X_2 can always be assumed to be not negative. In fact if in the original distribution negative values are possible a new frequency distribution

$$F_1(X_1, X_2) = F(X_1, X_2) + F(-X_1, -X_2),$$

may be taken. Then the frequency distribution of $x = X_1/X_2$ from $F_1(X_1, X_2)$ when X_2 cannot assume negative values will obviously be identical with the frequency distribution of x from $F(X_1, X_2)$, when X_2 may assume positive or negative values. Since, then, by hypothesis, X_2 cannot assume negative values, the frequency function of x is given by

$$\phi(x) = \int_0^\infty X_2 F(xX_2, X_2) dX_2 \quad \dots \quad (1)$$

which, by Fourier inversion of the characteristic function, is equal to

$$\frac{1}{4\pi^2} \int_0^\infty X_2 dX_2 \int_{-\infty}^\infty ds \int_{-\infty}^\infty e^{-iX_2(is+t)} f(s, t) dt \quad \dots \quad (2)$$

* Cramér, Harald (1937): "Random Variables and Probability Distributions."

Assuming that $|f(s, t)| = 0$ for $t = \pm \infty$ and for all values of s , partial integration of the integral in t on the right gives:

$$\phi(x) = \frac{1}{4\pi^2 i} \int_0^\infty dX_2 \int_{-\infty}^\infty ds e^{-iX_2 s} \int_{-\infty}^\infty e^{-iX_2 t} \frac{\partial f}{\partial t} dt \quad (3)$$

Set

$$\frac{1}{2\pi} \int_{-\infty}^\infty e^{-iX_2 t} \frac{\partial f}{\partial t} dt = g(s, X_2) \quad (4)$$

which equals zero when $X_2 < 0$. In fact

$$g(s, X_2) = \frac{iX_2}{2\pi} \int_{-\infty}^\infty e^{-iX_2 t} f(s, t) dt,$$

in which

$$f(s, t) = \int_{-\infty}^\infty e^{iX_1 t} \Phi(s, X_2) dX_2$$

with

$$\Phi(s, X_2) = \int_{-\infty}^\infty e^{iX_1 t} F(X_1, X_2) dX_1$$

so that

$$g(s, X_2) = iX_2 \Phi(s, X_2).$$

Since $F(X_1, X_2)$ vanishes for $X_2 < 0$ so does $\Phi(s, X_2)$ and hence so does $g(s, X_2)$.

On inversion, from (4),

$$\frac{\partial f(s, t)}{\partial t} = \int_0^\infty e^{iX_2 t} g(s, X_2) dX_2 \quad (5)$$

But, by (3) and (4),

$$\phi(x) = \frac{1}{2\pi i} \int_0^\infty dX_2 \int_{-\infty}^\infty ds e^{-iX_2 s} g(s, X_2),$$

which, by (5), on changing the order of integration, an operation assumed permissible,

$$= \frac{1}{2\pi i} \int_{-\infty}^\infty ds \left[\frac{\partial f(s, t)}{\partial t} \right]_{t=-\infty}^\infty \quad (6)$$

which is the expression required.

The condition for the validity of the extension that $|f(s, t)| = 0$ for $t = \pm \infty$ corresponds to Cramér's condition that

$$\int_1^\infty \left| \frac{f_2(t)}{t} \right| dt$$

converges.

It is doubtful if the present theorem has many practical applications. It does not seem, in fact, that, in general, the expression at (6) will be algebraically more manageable than the rudimentary formula at (1), since the characteristic is usually more complicated in form than the frequency function. When the parent universe is normal it is evident that the expressions at (1) and (6) are algebraically almost equivalent.

COMMENTS ON THE NOTE "ON A THEOREM CONCERNING SAMPLING"

By O. KEMPTHORNE

IN a recent note¹ in this *Journal*, "On a Theorem concerning Sampling," Mr. Simpson gave a proof of the theorem that, if i samples of size n_i , with means m_i and sums of squares about the mean $n_i s_i^2$, are taken from a normal population with zero mean, and a_i are arbitrary constants, subject to the relations $\sum a_i = 0$, and $\sum a_i^2/n_i = 1$, the quantity

$$\frac{\sum a_i m_i}{\sqrt{\sum n_i s_i^2}} \dots \dots \dots (1)$$

is distributed as $t/\sqrt{(\sum n_i - i)}$, where t is given by Student's " t " distribution with $(\sum n_i - i)$ degrees of freedom. The proof is interesting, but the result is not new, and is, in fact, the basis for the testing of a single degree of freedom in the analysis of variance. In his note, Mr. Simpson states, "in order that we may feel secure about our assumptions" ("that the samples were truly random and all drawn from the same normal population"), the probability of obtaining the actual ratio (1) or a higher one must be greater than 5 per cent. (supposing this to be the significance level chosen), whatever values the a_i may have, subject to $\sum a_i = 0$ and $\sum a_i^2/n_i = 1$. He proceeds to find the maximum value of the ratio, and by simple substitution of his results, it is found to be

$$\left\{ \frac{\sum n_i (m_i - \bar{m})^2}{\sum n_i s_i^2} \right\}^{\frac{1}{2}}$$

where $\bar{m} = \frac{\sum n_i m_i}{\sum n_i}$ is the general mean. He would then test this maximum value by the " t " distribution with $(\sum n_i - i)$ degrees of freedom.

The sum of squares of deviations of the sample values from the general mean may be divided according to the analysis of variance in the following way:

	D.F.	Sum of squares	Mean square
Between samples ...	$i - 1$	$\sum n_i (m_i - \bar{m})^2 = S_B$	$S_B/(i - 1) = B$
Within samples ...	$\sum n_i - i$	$\sum n_i s_i^2 = S_W$	$S_W/(\sum n_i - i) = W$
Total ...	$\sum n_i - 1$	$\sum (x_i - \bar{m})^2$	

It is well known that, if all the samples come from the same normal population, $z = \frac{1}{2} \log_e B/W$ is distributed according to Fisher's " χ^2 " distribution with $n_1 = i - 1$ and $n_2 = \sum n_i - i$ degrees of freedom respectively (or $F = B/W$ is distributed as e^{2z}). In the particular case when $n_1 = 1$, the distribution of F is the same as the distribution of t^2 for n_2 degrees of freedom. Mr. Simpson's proposed test assumes that, for samples from a normal population, B/W is distributed as $t^2/(i - 1)$, t being distributed according to Student's distribution with $(\sum n_i - i)$ degrees of freedom, which is clearly wrong.

The testing of (1) against the " t " distribution is only correct as long as the constants a_i are chosen without reference to the values of the means of the samples. The effect of using the incorrect test will be that differences between means will be judged significant far more often than they should be. Thus, for example, if there are 6 samples comprising in all 50 observations ($i = 6$, $\sum n_i = 50$), the differences will be judged significant in over 50 per cent. of all cases when a nominal level of significance of 5 per cent. is taken.

¹ Harold Simpson (1943), "On a Theorem concerning Sampling," *J.R.S.S.*, 106, 266.

NOTE ON WILSON AND HILFERTY'S APPROXIMATION TO THE χ^2 -DISTRIBUTION

By A. J. H. MORRELL

THE following remarks may be regarded as an introductory note to Wilson and Hilferty's method of approximating to the χ^2 -distribution for any given value of n , the number of degrees of freedom. The problem is to find a value of r that makes the χ^r -distribution nearly normal.

First, we may observe that, for any particular value of n , the median of the χ^r -distribution is given by the same value of χ for all positive values of r . Suppose χ_1 is the median of the χ -distribution, so that

$$\int_0^{\chi_1} e^{-\frac{1}{2}\chi^2} \chi^{n-1} d\chi = \frac{1}{2} \int_0^{\infty} e^{-\frac{1}{2}\chi^2} \chi^{n-1} d\chi.$$

On putting $\zeta = \chi^2$, we obtain a similar equation for ζ in which the median of the ζ -distribution is given by the upper limit of the new left-hand integral, viz., χ_1^2 . In other words, the median of the χ^r -distribution corresponds to a value of χ which is independent of r , and depends only on n .

Now, since the mean and mode of the χ^2 -distribution are n and $n-2$ respectively, its median, for large values of n , will be approximately $n - \frac{2}{3}$. The median of the χ^r -distribution, therefore, will also be given approximately by the equation

$$\chi^2 = n - \frac{2}{3}.$$

But it is easily shown that the mode of the χ^r -distribution is given by the equation

$$\chi^2 = n - r.$$

Hence, when $r = \frac{2}{3}$, the median and mode, and consequently the mean also, practically coincide, and the $\chi^{\frac{2}{3}}$ -distribution is very nearly symmetrical. One would expect, therefore, that the $\chi^{\frac{2}{3}}$ -distribution would approximate to the normal distribution exceedingly well. Wilson and Hilferty's method, which is based on it, does in fact give estimates of χ^2 very close to the true values.

THE INDUSTRIAL APPLICATIONS GROUP OF THE ROYAL STATISTICAL
SOCIETY: SECOND SESSION, 1943-44

Report by BERNARD P. DUDDING, Chairman of the Organizing
Committee

THE Council of the Society appointed the following as the Organizing Committee of the Industrial Applications Group for the year 1943-44: Dr. H. E. Daniels, Dr. B. P. Dudding (Chairman), Dr. E. J. Gooding, Mr. W. J. Jennett, Prof. E. S. Pearson, Mr. H. Rissik, Mr. J. F. Stanley, Mr. A. W. Swan, Mr. L. C. H. Tippet, Dr. B. L. Welch, and Mr. J. Womersley. Mr. Jennett has acted as Secretary to the Organizing Committee.

The Group has met on five occasions, October 8th, 1943, November 19th, 1943, January 14th, 1944, March 17th, 1944, and May 10th, 1944, each Group meeting being preceded by a Committee meeting. The discussions were well attended.

The following is a brief summary of the proceedings at the meetings.

First Meeting, October 8th, 1943. Chairman: Dr. Bernard P. Dudding

"The installation of Quality Control in a factory," introduced by Mr. A. W. Swan.

Mr. Swan's review covered the many aspects of the problem indicated by the title, in the light of considerable personal experience. His contribution ranged from the nature of the approach to the principal executives of the factory to the more intimate details concerned in the first attempts to associate "quality control charts" with the results of patrol inspection, whether the latter was normally practised in the factory or not.

A lively discussion followed, and whilst there was general agreement on the details of procedure best suited to the inauguration of the statistical method in the factory, there was more divergence of opinion on how and at what stage the interest of the principal executives should be enlisted, and on the type of personnel who should do this. The discussion revealed that considerable thought and effort had been directed to problems, other than statistical and technical, arising when statistical methods are first placed before industrialists.

The differences of opinion were obviously due largely to the type of organizations with which those who joined in the discussion had been associated.

The discussion demonstrated that as experience was gained a further meeting devoted to the subject would prove valuable.

Second Meeting, November 19th, 1943. Chairman: Mr. J. Womersley

"Machine tool performance as revealed by Quality Control Technique," introduced by Mr. A. Brown.

Mr. Brown emphasized that the short-period variability in the dimensions of articles produced by machine tools is a measure of the repetition accuracy of the tool, and pointed out that this variability is conveniently measured by the average range in the dimensions of small samples made in such time and under such conditions that influences external to the fundamental operation

cycles of the machine have negligible effect. Mr. Brown catalogued machines in some generalized classes and quoted data from experience which illustrated how the average range in samples of the same size varied for different classes of machine from 0.0002 in. to 0.005 in. He indicated that this value differed for operations of different types on the same machine, and sometimes changed with the age of the machine.

He also pointed out that such information concerning the performance of machine tools was of value when planning production to specified limits, and would in due course be of value to designers.

During the discussion reference was made to the contention, sometimes urged that quality control has little application in shops where miscellaneous articles are produced in relatively short operational runs; but Mr. Brown's communication indicated how by following the procedures of Quality Control technique, valuable information is provided which would serve to aid efficient manufacture under these conditions, even when a particular class of work is on a machine for only a few hours.

The Chairman, in closing the meeting, indicated that Mr. Jennett, acting as Secretary to the Organizing Committee of the Industrial Application Group, would be pleased to classify data if members of the audience would send him particulars of machine performance. (It is known that data of this type are being collected by a number of engineering organizations, and it is suggested that the Group should take some step to collect the information for the purposes of a future discussion.)

Third Meeting, January 14th, 1944. Chairman: Mr. H. Rissik

"Quality Supervision by Sampling Inspection," introduced by Mr. H. Rissik and Mr. A. W. Swan.

Mr. Rissik indicated the following three principal inspection procedures which can be used to determine whether or not a product satisfies specification requirements:—

- (1) 100 per cent. inspection of the product.
- (2) Evidence provided by control charts recording the results of the inspection of samples selected during manufacture.
- (3) Testing samples randomly selected from bulk deliveries without prior knowledge of the level of quality of the product.

Mr. Rissik stated that the attention of the meeting would be directed principally to item (3), with particular reference to qualitative classification—*e.g.*, by the use of "go" and "not go" gauges.

He illustrated diagrammatically for specific sampling specification clauses the large differences that can arise between the average levels of quality which provide satisfactory statistical risks to the producer and consumer respectively. He referred to and briefly described the systems of single and double sampling which have been published by Dodge and Romig of the Bell Telephone Laboratories, New York.

Mr. Swan described schemes for qualitative sampling inspection of a product, and emphasized the inevitable conflict between consumer's and producer's risks when a product is judged solely by the qualitative testing of samples. He described, diagrammatically for products having different proportions of

defectives, how for defined consumer and producer risks suitable sizes of samples can be determined.

In discussion, a number of important aspects of the subject were raised, among which were: that, contrary to the generally accepted belief, there is a consumer's risk associated with 100 per cent. inspection; that the Dodge-Romig scheme is unsuited to circumstances where the quality level is liable to fluctuations, because it assumes some knowledge of the quality level of the product under examination; that the Dodge-Romig system can be usefully applied at intermediate stages of manufacture to avoid passing on defective material to later operations.

Fourth Meeting, March 17th, 1944. Chairman: Mr. H. Rissik

Subject: "Quality Control Technique and Time Study, Costing and Bonus Payment Systems," introduced by Mr. A. S. Wharton.

In introducing this subject, Mr. Wharton associated manufacturing difficulties with three main sources: raw material, machine defects, and variations in skill or care of operators.

Concentrating on the latter, Mr. Wharton described arrangements, based on general experience and evidence provided by control charts, whereby operators could earn bonuses for work better than specified levels and contrarily lose bonus for failing to maintain levels of quality previously attained. It was pointed out that difficulties can arise from faulty material or machines, and that consequently bonus adjustments have to be made.

Statistical methods had been used to study the variation between operators employed on the same work in order to provide guidance in rate fixing and production planning.

In discussion reference was made to the initiative displayed in this attempt to link "payment by results" with the statistical technique of watching the quality of products during manufacture. However, the general discussion which followed indicated that at the present stage of development formal interpretation of statistical data was not always the primary consideration.

It is of interest to note that, as at the previous meeting, reference was made by more than one speaker to the fact that undesirable variation was found in products after being subjected to 100 per cent. inspection.

Fifth Meeting, May 10th, 1944. Chairman: Mr. J. Womersley

Subject: "Analyses of Variance applied to the study of machine tool performance," introduced by Mr. W. A. Bennett and Dr. J. W. Rogers.

In his opening remarks the chairman pointed out that the subject matter placed before the meeting was the result of the joint efforts of the personnel of a manufacturing organization, the statistical department of a Ministry and a professional computing service. One of the principal aims was to demonstrate to those responsible for manufacturing processes how the data collected as a routine procedure to aid satisfactory production could at a later date be utilized as a basis of enquiry into the process, and thereby frequently provide new information and/or stimulate improvements.

Dr. Rogers, in presenting the data, explained how the methods of analysis enabled the variability of the results to be subdivided into contributions from various sources. For example, the variance of the bulk was the sum of the

"machine" variance—*i.e.*, the random variation always present in the process—and the "setting" variance—*i.e.*, the changes in process level as production proceeds. In general the results, which were illustrated diagrammatically, indicated that the "setting" variance was about double the "machine" variance. He pointed out that this information concerning the relative magnitude of the variability arising from the two sources could be obtained only by analysis, and is not provided during the normal operation of control chart technique.

Dr. Rogers also described how the work had included a study of various technically recognizable factors, including the accuracy of measurements in which a number of observers were involved. During the discussion it was emphasized that Dr. Rogers' investigation of variability in measurement referred to a problem worthy of more attention than it usually received. It is important, when making measurements under conditions imposed by production conditions, to determine what proportions of the total variability in results are attributable to different sources, such as the same observer and the same instrument on the same and on different occasions, of different instruments of the same kind, and different observers.

As this was the first occasion on which a statistical method other than the construction and use of the control chart had been discussed, it was not surprising that some of the discussion did not arise out of the subject-matter.

However, the discussion showed that there was a sufficient number of production and inspection engineers with a working knowledge of the operation and theory of the control chart, to justify devoting an occasional meeting to the illustration of some statistical method likely to have a general industrial interest.

During the discussion Dr. Hartley showed how economies in the labour of computation had been made by grouping the results, without detriment to the accuracy of the work, and this led to a number of questions by those present, which served to emphasize the importance of planning the work when analysis of mass data is undertaken. It appeared that at some later date, when more engineers became interested in analysis of accumulated data, a paper on the methods of handling the data would serve a useful purpose.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*American Agriculture, 1899–1939*. By Harold Barger and Hans H. Landsberg. New York: National Bureau of Economic Research, Inc. 1942. 9" x 6". xxii + 440 pp. \$3.

The concept of agricultural production is obviously not a simple one. Where should the boundaries be drawn, in time and space; between milk and cream, milk and butter, milk and cheese, milk and plastics; between milk fed to calves direct or from buckets, fed to farmers and their families or their workers, or to townspeople? Further problems arise when one comes to consider agricultural output or net output as a whole, allowances for fertilizers, machines, imported feeding-stuffs, so-called overdrafts on the soil, and other relevant questions, some of which in our present state of knowledge may appear almost insoluble. A fundamental problem is the unit in which output is to be measured. An apparently simple solution is to adopt as weights the prices in some basal period, but its simplicity is more apparent than real, and in war-time it may be seriously misleading. For then the vital aim may be not to maximize, but possibly completely to ignore the monetary value of agricultural output, and instead to maximize output measured in food values or shipping space involved, according to internal labour needs, supplies of ships, and the willingness of countries overseas to supply particular classes of foods. Further problems of definition or classification arise when one comes to such concepts as agricultural land, farms or farmers—what is a farm, who is a farmer or a farm worker, what is agricultural labour and how shall it be measured?

Some of these problems have been tackled, some avoided, in *American Agriculture, 1899–1939*. The authors define agricultural land as the aggregate of farms falling within the U.S. census definition of a farm—that is, all land which is directly farmed by one person conducting agricultural operations either by his own labour or with the assistance of members of his household or hired employees. The term agricultural operations is used as a general term referring to the work of growing crops, producing other agricultural products, and raising domestic animals, poultry, and bees. From 1910 instructions have been given to include tracts of land of less than three acres if agricultural products to the value of \$250 or more are produced yearly on such land, but in the preceding census there was no lower limit to acreage or value of output. It must be remembered that the three-acre limit excludes certain quantities of milk and poultry, and, in particular, of vegetables. The authors have further excluded the products of nurseries, greenhouses, hatcheries, apiaries, and forestry, but on the question of whether or not to include products destined for State relief they seem to change their mind.

They define output, which they alternatively refer to as net output, as consisting of those products which are not consumed in further processing within agriculture, but are available for consumption elsewhere: they include products sold to non-farm purchasers and products used by farm families as consumers, and they aim at including increases or decreases in stocks. To include stock changes was an admirable ideal, but the data available seem to have left it a pious hope rather than a statistical achievement.

Defective data hampered the authors at many other points, as, for instance, when sales of crops for seed or feed are inseparable from other sales, when estimates of crops used for feed are fixed percentages of the total crop, when in the earlier periods there are no data for important truck crops, and, in particular, when the data relating to agricultural labour are sparse and unreliable. But good use has been made of the available data, and the book may be regarded as a useful pioneer work containing a mass of illuminating material and diagrams for those interested in American agriculture.

The authors believe that the principal scope for the future expansion of agricultural output lies in the production of larger quantities of the so-called protective foods, but that in view of population trends any greatly increased demand for the older staple foodstuffs, for textile fibres, or for tobacco is much more problematical. The authors point out that trends in output, employment and output per worker in agriculture showed striking contrasts to analogous trends in manufacturing industries since the beginning of the century: in output an increase of 50 per cent. against a 300 per cent. increase; in number of workers a slight falling off compared with a rise of 100 per cent., and in output per worker a less striking difference of a 50 per cent. increase in agriculture against a 100 per cent. rise in manufacturing industry.

The declining relative importance of agriculture as an employer of labour is partially due to the definition of agricultural production, since this is reduced when, say, butter is made off instead of on the farm. There are other factors also operating in the same direction, but few operating in the opposite direction. The authors maintain that a further rise in the standard of living may induce larger but not proportionately larger expenditures on food, and increasing average age of the population tends to reduce average expenditure on food. They go on to argue that where the income elasticity of demand for any industry's products is zero, then any increase in labour productivity must lead to a decline in its percentage share of occupied population, a statement which with the economists' saving clause of *ceteris paribus* is barren and without it has no logical foundation.

But these are small points. The authors' conclusions, subject to certain conditions stated or understood, seem difficult to controvert. They are summed up, lucidly and reasonably, in a final chapter entitled "Agriculture in the Nation's Economy," but the authors do not have the last word.

For Mr. C. Reinold Noyes, Director of the National Bureau of Economic Research, has inserted a long note critical of the whole work. The authors' main conclusions that aggregate agricultural output in the United States will shortly cease to increase, and that the trend of the past twenty years towards an absolute reduction in those gainfully employed in agriculture will continue, which they surround with carefully considered conditions, are drastically attacked, sometimes without any mention of their conditional character.

In view of the nature of many of Mr. Noyes' arguments, it seems a pity that the authors did not, or were not, permitted to reply, although one may view with some misgiving the possibility of the general extension of this form of literary attack and counter-attack. Its general adoption would certainly brighten, if not ease, the task of reviewers, although one might justifiably fear how long, with an endless succession of rebuttals and rejoinders, the future American textbook might become.

C. O. G.

2.—*Cost Behaviour and Price Policy. A study prepared by the Committee on Price Determination for the Conference on Price Research.* New York: National Bureau of Economic Research. 1943. 9½" × 5½" xix + 353 pp. \$3.

I do not know which amazes me most: the factual and theoretical contents of this work, or the methods employed across the Atlantic. This report is produced by the Committee on Price Determination, which was set up by the Conference on Price Research, which itself was called into being by the National Bureau of Economic Research. This is a first report! Nor must one be misled into thinking that it is itself simply an investigation into Cost Behaviour and Price Policy. It is particularly an investigation into the methods of investiga-

tion already employed. It sets out to survey the attempts already made to apply methods of empirical research to problems connected with the behaviour of costs in the individual enterprise, and to explore possibilities for further research. Further reports will deal with other aspects of the problem.

In spite of the exploratory nature of this study, considerable ground is covered, and a number of important concepts are isolated and developed. The width of the gap between the theoretical and the empirical work in the field of price formation is clearly and beneficially demonstrated. The theoretician has proceeded along the path necessitating the consideration of the operations of individual productive units under various assumed demand and cost conditions. To many of us, this process seems to have been unduly extended, save where the firms can be suitably grouped into markets or industries. On the other hand, it is necessary to recognize the important element of distortion which may arise by the assumption of competition in many markets. In any case, the speculations of the theorists, commonly relating to the reactions of individual firms to assumed changes in cost and demand conditions, have passed well beyond the limit at which the conclusions can be tested by investigation.

Two main methods of empirical study have evolved as a counter to the theoretical treatment of this subject. Firstly, there have been those investigations concerned with the changing relationships over time of broad groups of commodities in a "price system," the prices being those of "representative" articles: secondly, there are the "output-price sales" relationships of particular goods. Almost entirely absent are the studies of the cost and demand complexes of individual concerns. Such studies are of primary importance both to the business-man, the economist and the administrator. This report does much to clear the ground for this type of inquiry. In particular, it draws attention to the fundamental need for careful definition of the word "cost," a word that is made to play many—perhaps too many—parts. This is hardly a book for the non-specialist, but it is of marked value to the student of the narrow field with which it deals.

F. E. R.

3.—*The Canadian Born in the United States: An Analysis of the Statistics of the Canadian Element in the Population of the United States, 1850 to 1930.* By Leon E. Truesdell. New Haven and Yale University Press. 1943. 9½" x 7". xvi + 1 + 263 pp. 20s.

In a recent review of *The American Born in Canada* by Coats and MacLean, I made mention of the above-named work without realizing that it had itself escaped the attention of the Society's reviewers. This omission I now, belatedly, propose to correct. *The Canadian Born* is published in a uniform edition to *The American Born*, and the laudatory remarks which the production and arrangement of the latter evoked apply equally to the former. Both, in my very personal opinion, would have benefited from a fuller use of diagrams, but this, as previously confessed, may be taken as the expression of a desire for perfection beyond reasonable expectation.

The picture developed in this volume has, I must admit, a less novel basis than that of its companion, so far as I am concerned: I had assumed that there would exist a substantial migration in the direction of the United States, but had not appreciated the magnitude of the reverse current. My interest in this present treatise is particularly focused upon the effect of this southward movement, rather than on the movement itself.

After giving, in the introductory chapter, a succinct comparison of the similarities of development and culture of the two nations, Truesdell proceeds to deal fully and in great detail with the nature, and effect, of the Canadians upon the civilization of the United States. While it is not possible to deal fully or indeed partially here with this immense collection of factual matter, it does seem worth while to re-state some of the major conclusions derived from its analysis. It should be noted that the period covered is 1851–1931 in the case of Canada, and 1850–1930 in respect of the States. All references below are stated with regard to the latter period.

The following are, I consider, the major points arising out of the investigation:—

(a) In 1850, 0·64 per cent. of the American population had been born in Canada, while 2·60 per cent. of the Canadian population had migrated from the States.

(b) By 1930, these percentages had become 1·05 and 3·3 per cent. respectively.

(c) In 1930, the number of Canadian-born residents in the United States amounted to one-sixth of the Canadian population at that date.

(d) At the same date, although the American-born residing in Canada were numerically important, they represented a very small fraction of the population of the United States at that date.

(e) Since 1900, the Canadian migration has developed less rapidly, and the characteristics of the group inside the States have tended to become relatively static—the influx now appears to have less influence than the pool.

(f) As is to be expected, the inhabitants of the States of Canadian origin are more like the native population than are other foreign-born immigrants, although certain important differences do exist.

(g) The Canadian-born tend to find their homes in urban areas to a greater extent than do the native-born, and they tend to be found mainly in the New England States.

(h) The proportion of the Canadian immigrants with French as mother-tongue was similar to that for the whole Canadian population.

These two books are of the greatest importance to all serious students of post-war international problems: Canada clearly emerges as the fundamental link between the United States and the British Empire.

F. E. R.

STATISTICAL NOTES

(1) BRITISH OFFICIAL STATISTICS

During the first six months of 1944 the general level of wholesale prices moved gradually upward, but this was due entirely to increased prices of industrial materials and manufactures, the prices of articles of food and tobacco showing on the whole a decline. According to the Board of Trade index-number, the general level of prices advanced 1·7 per cent. There was a fall in prices of food and tobacco of 0·4 per cent., while prices of industrial materials and manufactures advanced 2·8 per cent. Cotton prices rose during the period rather more than 16 per cent., and coal prices 8·6 per cent. (about 3s. per ton on the average). There were, however, advances more or less considerable in other articles—e.g., hides and skins (both calf and goat skins), glass, jute, roofing tiles and bricks (both pressed and stocks). The slight fall in food prices was due to a decline in the prices of English malting and other barley. There were fluctuations in the effective prices paid by millers for home-grown wheat and some seasonal changes in fruit prices. Prices of meat, fish and eggs remained stationary throughout the half-year. Since the beginning of the war general wholesale prices have risen over 69 per cent., industrial materials and manufactures advancing 66·7 per cent., and food and tobacco prices 74·4 per cent.

(Averages for the year 1930 = 100)

Date	Total Food	Total not Food	All Articles	Basic Materials (excluding Fuel)	Intermediate Products	Manufactured Articles	Building Materials
Dec. 1943 ...	158·3	165·7	163·4	177·6	172·5	156·5	150·6
Jan. 1944 ...	158·7	166·4	164·0	178·5	172·8	157·5	152·1
Feb. " ...	158·7	167·4	164·6	178·7	172·8	157·6	152·3
Mar. " ...	158·4	168·0	164·9	180·2	173·0	158·1	152·9
Apl. " ...	158·1	169·0	165·5	183·0	174·7	157·8	152·9
May " ...	158·1	169·9	166·1	185·4	176·2	157·7	153·0
June " ...	157·6	170·3	166·1	186·1	176·3	158·1	153·4
June 1943 ...	161·3	163·7	163·1	173·9	171·4	154·3	150·0
Aug. 1939 ...	90·4	102·2	98·1	94·5	104·0	108·7	104·1
Percentage increase in June 1944 over—							
Dec. 1943 ...	0·4*	2·8	1·7	4·8	2·2	1·0	1·9
June " ...	2·3*	4·0	1·8	7·0	2·9	2·5	2·3
Aug. 1939 ...	74·4	66·7	69·3	97·0	69·3	45·5	47·4

* Decrease.

The group index-numbers showing the most considerable advances are: cereals (99.9 per cent.), basic materials (97 per cent.),* cotton (95.7 per cent.), textiles other than wool and cotton (81.6 per cent.), food other than cereals and meat (81.1 per cent.), wool (79.4 per cent.), and the miscellaneous group (92.4 per cent.). There has been very little change in the group index-number for non-ferrous metals over the last two years, which has advanced only 27.2 per cent. since August 1939. There was, however, a rise in tin prices of about 9 per cent.

The Board of Trade index-numbers for the first six months of 1944 are shown below.

The figures for certain other British index-numbers of wholesale prices and those of the United States Bureau of Labour are set out below.

Date	Board of Trade (1930 = 100)	<i>Economist</i> (1927 = 100)	<i>Statist</i> (1886-77 = 100)	<i>The Times</i> (1913 = 100)	United States Bureau of Labor (1926 = 100) *
Dec. 1943	163.4	113.7	153.9	177.6	102.9
Jan. 1944	164.0	114.5	154.9	179.2	103.1
Feb. "	164.6	115.2	155.1	180.5	103.3
Mar. "	164.9	115.1	155.7	180.6	103.5
Apl. "	165.5	117.6	157.9	183.8	103.7
May "	166.1	117.6	159.5	185.1	103.8
June "	166.1	117.6	160.0	185.0	—
<i>June 1943</i>	<i>163.1</i>	<i>114.8</i>	<i>155.4</i>	<i>178.3</i>	<i>103.6</i>
<i>Aug. 1939</i>	<i>98.1</i>	<i>70.3</i>	<i>90.4</i>	<i>114.5</i>	<i>74.8</i>
Percentage increase in June 1944 over—					
Dec. 1943	1.7	3.4	4.0	4.2	—
June "	1.8	2.4	3.0	3.8	—
Aug. 1939	69.3 ...	67.3	77.0	61.6	—

* Mean of weekly prices.

There has been very little change in the cost of living and in retail prices during the first six months of 1944. According to the index-number of the Ministry of Labour and National Service of retail prices of food and other articles of working-class consumption, the only change in food prices was a seasonal advance in June in the price of potatoes. There was an advance in coal prices on February 1st of 3s. per ton, and a slight advance in the spring in the prices charged for men's suits and overcoats. The result of these changes

* The *Board of Trade Journal* states: In general, there is not a very great difference between the price rises shown at the various stages of manufacture of any one article, and in several cases the rise has actually been least for the raw material because the full effect of a subsidy is visible there. The true explanation of the greater rise shown by the raw materials index is essentially that it contains various items, such as paper-making materials which have increased enormously in price and for which there is no quotation available at later stages of manufacture; similarly, the index for intermediate products is raised above that for manufactured articles, mainly because it includes timber.

caused the general index-number to advance from 199 at January 1st, 1944, to 201 at July 1st, a rise of about 1 per cent.

(Prices at July 1914 = 100)

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	All Items
Jan. 1st, 1944 ...	168	164	340-345	244	291	199
Feb. 1st, " ...	168	164	340-345	252	291	200
Mar. 1st, " ...	168	164	340-345	251	291	200
Apl. 1st, " ...	168	164	340-345	252	291	200
May 1st, " ...	168	164	345	252	291	200
June 1st, " ...	168	164	345	253	291	200
July 1st, " ...	169	164	345	253	291	201
July 1st, 1943 ...	168	164	345-350	244	286	200
Sept. 1st, 1939 ...	138	162	205-210	180-185	180	155
Percentage increase at July 1st, 1944 over Sept. 1st, 1939 ...	22	1	66	39	63	55

(2) OTHER STATISTICS

A NOTEWORTHY change in the *North American Wheat Supply* occurred in 1943-44 owing to an exceptional use of wheat in the United States for the feeding of live-stock. This was due to the unprecedentedly large numbers of cattle, calves, pigs and poultry raised in 1943. Expressing them in terms of "animal units," the live-stock and poultry population at the beginning of 1944 totalled almost 171 million, which was 7 per cent. more than the high record of the preceding year, while at the same time stocks of maize and oats were almost 15 per cent. lower. As a consequence, the United States was compelled to purchase huge quantities of Canadian wheat, and for the first time for more than a century ranked as the second largest importer in the world. It is estimated that probably 600 million bushels of home-grown and imported wheat were used for feeding and for the manufacture of industrial alcohol—a larger quantity than that milled for domestic consumption and export. This heavy diversion of wheat to non-food uses sharply reduced the stocks held in the United States and Canada, and it was provisionally estimated that at the end of the crop year in July 1944 they would amount to only 670 million bushels, as compared with 1,210 million bushels in July 1943. This quantity was still large compared with pre-war years—the figure for 1938-39, for example, being 354 million bushels—but would not permit the continued utilization of wheat for non-food purposes at the same rates as in 1943-44. A reduction in the live-stock numbers in the United States appears to be indicated. It also implies a consequential reduction in the world wheat stocks, *i.e.*, the stocks carried over, which for several years have reached abnormal figures.

The above note is summarized from information given in *World Wheat Survey, May 1944*, published by the Food Research Institute, California.

The same publication has some observations on the *Wheat and Food Position in Russia*. By the spring of 1944 the Soviet Union had regained control of all the principal agricultural regions which normally produce the food surpluses required to supply deficits in industrialized and other regions, but a considerable period must elapse before this results in any great easing of the food problem of the U.S.S.R.

A fair restoration of crops, approaching pre-war normal, can be expected only in that part of the liberated area that was regained during the winter of 1942-43—i.e., the Northern Caucasus and the Don region. The wheat and other grain produced here over and above local requirements will be the main source for improving the bread-grain situation in the Soviet Union in 1944-45. Apart from this, practically the whole territory reconquered after July 1943 was liberated after the grain crops were harvested, and there can be little doubt that the bulk of the produce was removed or destroyed by the enemy, with the result that the population of the liberated areas would be dependent on supplies from other parts of Russia at least until the summer of 1944. The best that can be expected from territory liberated from July 1943 to the spring of 1944 is that it will produce enough food in the summer of 1944 to meet the requirements of the local population in the following crop year, and that it will cease to be a drain on supplies produced elsewhere. Consequently the great recovery of Russian territory effected in 1943-44 cannot be expected to result in a material improvement in Russian food supplies until after the harvest of 1945.

Some idea of the food situation in Russia generally can be gathered from the rations which were reported in the Press to be ruling in the winter of 1943-44 and likely to prevail until the harvest. The rations for bread are given in grams per day while those for other food are on a monthly basis.

Category of consumer	Bread (grams per day)	Meat (grams per month)	Fat (grams per month)	Sugar (grams per month)	Cereals (grams per month)
Manual worker	650-750	2,200	750	750	1,950
Employee	450-550	1,200	400	400	1,475
Adult dependent	300	600	200	100	1,000
Child	300	600	400	400	1,200

Taking 1 lb. as equal to 454 grams, the bread ration for manual workers is from $1\frac{1}{2}$ - $1\frac{3}{4}$ lb. per day, for employees 1 - $1\frac{1}{4}$ lb., and for adult dependents and children about two-thirds of a pound daily. The other rations, it will be seen, are extremely small: meat in the case of the manual worker being less than 5 lb. per month, and for employees only a little over $2\frac{1}{2}$ lb., while the fat and sugar rations are correspondingly low. Rations of these foods are, it is said, much lower than those prevailing at the same period in Germany, and lower than in Belgium and other occupied countries.

The situation with respect to these foods, moreover, cannot be materially improved in 1944-45, in spite of the liberation of practically all Russian territory. The restoration of live-stock herds in the regained territories will require several years, and the sugar industry cannot be revived at all rapidly.

CURRENT NOTES

During the past months the Manchester Statistical Society has organized a series of meetings for engineers at which topics concerned with the statistical control of quality in production have been discussed. The meetings were arranged in response to a demand from some engineers (the demand had been received both directly and through the Royal Statistical Society); and the continued good attendance, the wide geographical area from which members came, and the liveliness of the discussions, show that a real need is being met. Some engineers in the Manchester District are overcoming their difficulties in applying statistics to problems of production and are gaining familiarity with the methods; and some firms evidently have well-developed systems of quality control forming an important part of their inspection procedure.

At the first meeting, on October 30th, 1943, Dr. B. P. Dudding gave a general introductory talk, and introduced the Relative Precision Index for showing the precision of a process relative to the precision required by the tolerance limits. On December 18th, Mr. L. H. C. Tippett led a general discussion that ranged over a wide field, including some of the points raised in Dr. Dudding's lecture. On February 5th, 1944, Mr. T. J. Lunt gave a paper well described by its title: "The Installation and Running of a Quality Control System in a Factory." On March 11th Mr. J. R. Womersley gave a talk on "Group Control Charts." On April 19th Mr. R. F. H. Banister gave a paper on "Proportion Defective Charts," in which he discussed the circumstances in which they are used, their theory and practice, their interpretation, and the use of compressed limit gauges. The meeting on May 20th, which ended the session, was addressed by Dr. E. H. Sealy on "Acceptance Sampling."

The Secretary of State for the Colonies has been considering ways and means of encouraging scientists to give special attention to problems of Colonial interest. On the advice of the Colonial Research Committee he has now decided to institute a number of "Colonial Research Fellowships," which will be open to qualified scientists, whether in the natural or in the social sciences, to enable them to pursue research work in the Colonial Empire. The Fellowships will normally be for two years, and the Secretary of State hopes that Universities and other research institutions will be willing to grant applicants, if already members of their staffs, leave of absence for this period in order to enable them to take up the Fellowships. Provision has been made for 25 such Fellowships within the next five years. It is recognised that war-time shortages of personnel will restrict the immediate applicability of the scheme; it is, however, being brought into force immediately, in case there are suitable candidates in any part of the Empire who are not at present required for urgent war-time work.

2. The award of these Fellowships will be made by the Secretary of State, on the advice of the Colonial Research Committee.

Qualifications of Applicants

3. The Fellowships will normally be reserved for University graduates under 35 years of age from any part of the British Commonwealth and Empire. Candidates must already have had some experience of research, and must have

given evidence that they have the ability to plan and prosecute investigations of a high quality without close and constant supervision.

Terms of Award

4. The Fellowships will be tenable normally for a period of two years provided that the Fellow's report from his supervisor at the end of the first year is satisfactory, and may be extended for a third year at the discretion of the Secretary of State.

5. The Fellowships carry a basic allowance of £400 per annum, which may be increased to a sum not exceeding £600 per annum if the Fellow is married, or in other appropriate circumstances. Travelling expenses and the cost of any special apparatus or material required for the Fellow's research will also be provided. Where a Fellow is a member of a superannuation scheme in which his employer pays part of the contributions, the Secretary of State will, if necessary, also take over the employer's contributions for the duration of the Fellowship.

6. Fellowships will be tenable in any part of the British Colonial Empire. Where practicable, Fellows will be attached to centres of higher education in the Colonies and may be required to give occasional lectures of general interest on their subject for the benefit of the students attending courses at such centres.

7. During his tenure a Fellow shall be responsible to a supervisor selected by the Secretary of State. If the supervisor is not resident in the territory visited, the Secretary of State may appoint, in consultation with him, a deputy supervisor in that territory or in a neighbouring territory.

8. The Fellow shall submit through his supervisor a concise progress report at the end of each year of his tenure, and a full report of his researches within a reasonable time on the completion of his tenure.

9. The award will be conditional upon the candidate being certified as medically fit for the type of work to be undertaken.

Applications

10. Applications should be addressed in the first instance to

The Secretary,
The Colonial Research Committee,
Colonial Office,
Downing Street,
London, S.W.1

and they should state the applicant's age, nationality, educational history, occupational history, and experience of research, and should indicate the precise nature of the problem on which the candidate wishes to do research. They should bear the endorsement of the Head of the College or research institute to which the candidate is attached, or of some other responsible person.

*Colonial Office,
May 1944.*

OBITUARY

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REGINALD HAWTHORN HOOKER, M.A.

By the death of Reginald Hawthorn Hooker, fourth son of the late Sir Joseph Dalton Hooker, O.M., on June 2nd, 1944, at the age of 77, the Society has lost a Fellow of long standing, one who in his younger days was actively associated with it, was a frequent contributor to the *Journal* and was awarded the Guy medal. Born at Kew on January 12th, 1867, Hooker was educated at the Collège Rollin, Paris (B.-ès-Sc. 1885), and at Trinity College, Cambridge (Mathematical Tripos, Junior Optime: B.A. 1889, M.A. 1893). In March 1891 he was appointed by the Council of our Society to the post of Assistant Secretary and sub-editor of the *Journal*. At that time Sir (then Dr.) Robert Giffen was editor of the *Journal*, an office which he had held in an honorary capacity for many years, and on his resignation some months later Hooker succeeded to the vacant post. One may also note that in 1891 he was elected a Fellow of the Royal Meteorological Society, a Society with which, in later years, he was to be more closely associated than with our own, serving on the Council in 1911-12, 1914-15, 1918-19 and 1924-25; as Vice-President in 1912-13, 1916-17 and 1922-23, and as President in 1920-21 and 1921-22. In 1895 he resigned his offices of Assistant Secretary and Editor of the *Journal* to take up duties in the Statistical Branch of the Board of Agriculture, and in November of that year was elected a Fellow of the Society. He remained with the Board—or the Ministry as it became later—until his retirement in 1927. In 1911 he married Olive Marian Rucker (*obit* 1933), daughter of Sir Arthur Rucker, F.R.S., by whom he leaves three sons and a daughter.

The bibliography at the end of this note gives a list of Hooker's published papers so far as I have been able to trace them, apart from reviews and apart also from the evidence presented by him on behalf of the Board of Agriculture to the Departmental Committee on Combinations in the Meat Trade (Cd. 4643, Cd. 4661, 1909). Space does not permit of any detailed consideration, but we may note that his first two contributions to the *Journal* date from the time when he was still Assistant Secretary. The title of the birth-rate paper of 1898 sounds intriguing at the present time: its conclusions proved over-optimistic, but the argument given therein as to the nature of the relation between the marriage-rate and economic factors is fundamentally important, and was further developed by the present writer (*J. Stat. Soc.*, vol. 69, 1906, pp. 10 *et seq.*). We then come to a batch of papers relating to agriculture and prices, the last of which leads up to Hooker's carefully argued discussion, 1901 (2), on the results of the suspension of the Berlin Produce Exchange, a communication which was deservedly awarded the Society's Guy Medal in silver. In these long-ago years Hooker took up with interest the method of correlation, developing methods for use in particular types of problem or illustrating its use by practical examples: 1901 (1), 1905, 1906, 1908, form a series of papers of this kind of which the first and second, though brief notes, are distinctly of historic interest, both dealing with the time-correlation problem. In the first, 1901 (1), fluctuations

in the marriage-rate and in exports are separated from their respective *trends* (this familiar term appears to be due to Hooker, *loc. cit.*, p. 486) by measuring deviations from an "instantaneous average" given by the 9 years of which each calendar year is the centre; and to determine the lag of the one set of fluctuations on the other correlations were calculated not only between marriage-rate deviations and export deviations of the same year, but between marriage-rate deviations and export deviations of years before and after. In the second paper, of 1905, the method introduced is that of correlating the first differences of the two series. In an appendix to the paper on the Berlin Produce Exchange some correlations were given between simultaneous prices in the several series with which the paper was concerned, but it could only be pointed out that they failed to give the information required: the difference-method solved the problem. In both these methods Hooker was the pioneer. Of his paper of 1907, on the weather and the crops, much might be said: this was again a pioneering investigation, but also an investigation on the grand scale, and a model of careful and cautious discussion on a subject in which he never lost interest, and to which he returned in later years. It was followed by only two more papers read before the Society, in 1909 and 1911. It was the first of these no doubt, on the meat supply of the United Kingdom, which led to his choosing the same subject for his theme when, in 1913, he was appointed Newmarch Lecturer at University College, London.

After 1911, Hooker, as already stated, became much more closely associated with the Royal Meteorological Society than with ours. His first paper to be contributed to their *Quarterly Journal* was that of 1908, an elementary example of correlation based on some data contributed by his brother, C. P. Hooker. With Mr. J. E. Clark he was jointly responsible for the Reports on the phenological observations for the years 1911, 1912 and 1913. But his great work here again lay in the extension and completion of his work of fifteen years earlier on the weather and the crops, given in his two Presidential Addresses. The first, of 1921, is a historic survey of the literature; the second, of 1922, repeats the earlier work, broadly speaking, with the additional data then available. All Hooker's writings, even the earliest and most purely descriptive, such as 1894 (1), on modes of census-taking, are characterized by a certain neatness of arrangement—always associated by me with the neatness of his handwriting—and a lucid simplicity of style; those that are more argumentative by caution in reasoning and a detailed and careful discussion of the meaning of the figures in relation to the facts. The importance and value of Hooker's scientific work, of which that on the weather and the crops is by far the most weighty, was never, in my opinion, appreciated at its proper worth by the Ministry at the time when he was still in its service. Mr. H. D. Vigor, who was formerly in the Ministry, wrote to me shortly after Hooker's death confirming this opinion:

"I look upon Hooker's two enquiries into the correlation of weather and crops as models of cautious deduction within the limits of the data and of the method pursued. It has always astonished me that agricultural research workers have ignored these quite classical studies, and, indeed, rarely know of their existence."

It would make some amends if, after the War—provided that has not led to gaps or imperfections or non-comparability in the data—the Ministry promoted another repetition of Hooker's research, say in 1947 or thereabouts.

In the letter from which I have just quoted Mr. Vigor also gave me the following personal reminiscence of Hooker:

"I first met him when I entered the Statistical Branch of the Board of Agriculture in 1908. He was then Head of the Branch. Looking back from this long distance of time, I am still grateful to him for the care he bestowed on me personally by having me sit in his room for a full month after I had joined, so that as a new-comer in the Department I could benefit from the personal contact and instruction. I continued as his chief assistant until 1914. He was very clear-headed and quick-brained. He was also a severe disciplinarian. I think there is no question that under him the Statistical Branch rose to a high level of efficiency, and a good many men who afterwards did very well in the Service owed not a little to the thorough mental discipline of working under Hooker. It was especially during his regime that much of the leisurely time-wasting procedure of an earlier generation was driven out and a more efficient, hard-working order of things took its place."

But this, inevitably, was not the Hooker I knew—I never met the stern taskmaster. The man I knew so well was a companionable soul, who joined with me in the early days of our acquaintance to form a very select Junior Statistical Dining Club of two members, which met fairly regularly after meetings of the Society: who was capital company on many a holiday in the Lake District, in Wales, and in Cornwall, in years when we were both good walkers: who was only too glad, on retirement, to live far away from all thoughts of the Ministry in an old farmhouse at Harwell, on the edge of the foothills of the Berkshire downs, and to lead a quiet family life. I should be sinning my mercies if I were not deeply grateful for so tried a friend of half-a-century and for the unbroken kindness I owe to him and to his wife, not forgetting, especially in that hospitable house at Harwell, the younger generation also.

G. UDNY YULE

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ROBERT HOLLAND-MARTIN, C.B.

THE death of Mr. Robert Holland-Martin, on January 27th, 1944, terminated an association with the Society of the family and banking-house of Martin, which began with the election, in the 'seventies, of his uncles Richard and John Biddulph Martin. The latter became an Honorary Secretary and eventually President; the former was Honorary Treasurer from 1875 until his death in 1916, when his nephew Robert was appointed to succeed him. Mr. Holland-Martin relinquished this office in 1934 when the calls upon his time and energy had become so many and insistent that some of his activities had to be abandoned. It was with regret that he severed his long connection with the Council, but he felt unable to give enough of himself to the Society's affairs and, as all who knew him would testify, he would not take part in any work without shouldering responsibility. The truth is that while fully recognising the importance of statistics and using them for his own purposes, he was very much more interested in other departments of knowledge and other aspects of life.

Robert Holland-Martin was born on November 10th, 1872. His parents were the Rev. Frederick Whitmore Holland, Vicar of Evesham, and Penelope, daughter of Robert Martin of Overbury, Worcestershire. He married a third cousin, Eleanor, daughter of G. E. Martin of Ham Court, Upton-on-Severn, and had six sons, of whom the eldest fell in action in France in 1918. The second, Edward, is a director of the Bank of England. Mr. Holland-Martin spent much of his youth at Overbury Court, at the foot of Bredon Hill, which he ultimately inherited from his uncle Richard, taking by the latter's desire the additional surname and the arms of Martin. From that time his life was divided, as his affections had always been, between his country estate, where he spent busy week-ends, and Martin's Bank, with his other activities in London. These were many and varied. The Southern Railway, of which he became Chairman in 1935, absorbed more and more of his time and zeal in recent years. He was also a director of the Union Discount Company, the Alliance Assurance Company and the Gas Light & Coke Company, and was for many years an Honorary officer of the British Red Cross Association and St. John's, and also of the London Territorial Association; from 1925 to 1932 he was Chairman of the Territorial Army and Air Force Association. In addition, he was Honorary

Treasurer of various charities and of the Society of Antiquaries, of which he had long been a member and whose subject-matter responded to a very vital part of his nature—his love of tradition and of beautiful things. He took an immense interest in the history and antiquities of his own neighbourhood and an active part in the preservation and improvement of its amenities and character. In 1938 he was High Sheriff of Worcestershire. He was a keen farmer and an excellent landlord, looking into every detail and seeing that justice was done. The same spirit made him take endless pains to find out the real facts whenever he had to assist in making a decision affecting the policy of his railway or any other enterprise in which he was involved. He was, undoubtedly, one of the most industrious of men, one who seldom wasted a moment and got through an immense amount of useful work, all quietly and without the least fuss; he never hustled or seemed to labour. He found time for numberless kindnesses, for many friends, for social pleasures and sport—and he enjoyed his life. His tastes were simple and he was a singularly modest man, as is evident from the concision of his statement in *Who's Who*. For thirty years he was Honorary Secretary of the Bankers' Clearing House and during the 1914–18 War was responsible for a very large part of their Committee's work in connection with the national finances. Mr. Holland-Martin was, as usual, at great pains to keep himself in the background, and only those inside knew how much of the hard work was his. He greatly disliked being rewarded for doing what he thought his duty and was reluctant to accept the honour of Companion of the Bath conferred on him in 1911 for his work in organising the London Territorials.

Perhaps no one will be so greatly missed in so many places as "Rob" Holland-Martin. It is difficult to think of either "the Grasshopper in Lombard Street" or of Overbury Court and village without his genial presence.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

UNITED KINGDOM—

Agenda—

May 1944—Am I my brother's keeper?: *Barbara Wootton*. The future of British Restaurants: *Gordon Taylor*. Economic battlefields, old and new: *J. R. L. Schneider*. Some notes on the future size of British coal industry: *A. Beacham*. The demand for dwellings in Great Britain after the war. Part II: *M. A. Abrams*.

The Banker—

June 1944—The Fund under fire: Imperial Preference: *D. J. Morgan*. The cartel system—its future: *Baron Boël*. Inflation in the Far East: *Paul Bareau*.

July 1944—Central Banking in evolution. Disruptive factors in international equilibrium: *Ernest H. Stern*. International double taxation: *F. Bower*.

August 1944—Britain's unlimited liability War: *Paul Bareau*. "Schachtian devices": *Paul Einzig*.

September 1944—The Bank of England as an independent Central Bank: *E. Victor Morgan*. War finance in New Zealand: *J. H. Lawrie*. Australia's Exchange position: *Paul Bareau*.

Bankers' Magazine—

June 1944—Progress of banking in Great Britain and Ireland during 1943. Joint statement on international exchanges.

July 1944—Latin-America: the crest of the wave: *Akanthos*.

August 1944—June Bank statements.

Biometrika—

August 1944—On autoregressive time series: *M. G. Kendall*. Comparison of the concepts of efficiency and closeness for consistent estimates of a parameter: *R. C. Geary*. Relation between measures of correlation in the universe of sample permutations: *H. E. Daniels*. The control of industrial processes subject to trends in quality: *L. H. C. Tippett*. Studentization, or the elimination of the standard deviation of the parent population from the random sample—distribution of statistics: *H. O. Hartley*.

Economica—

August 1944—A retrospective view of the Bank Charter Act of 1844: *P. Barrett Whale*. The joint statement by experts on the establishment of an International Monetary Fund: *E. Victor Morgan*. Commodity Stocks and the Trade Cycle. 1. A note. 2. A reply, by *K. Lacey*: *Harry Norris*.

Eugenics Review—

July 1944—The social environment and eugenics: *R. M. Titmuss*.

Manchester Statistical Society, Transactions—

Session 1943-44—Place of statistics in general education and vocational training: *L. H. C. Tippett*. The future of the banks: *Geoffrey Crowther*. The significance of forward transactions: *R. G. Hawirey*. Planning and economic privilege: *G. L. Schwartz*. Statistics in peace and war: *H. Campion*.

UNITED KINGDOM—Contd.

Oxford Institute of Statistics, Bulletin—

Vol. 6, No. 8—Change in non-ferrous metal prices: *S. Moos*. The plastics industry: *D. B. Halpern*.

Vol. 6, No. 9—The White Paper on the National income and expenditure in the years 1938–1943: *M. Kalecki*. Food consumption in the United Kingdom, the United States, and Canada: *T. Schulz*.

Vol. 6, No. 10—Distribution of the war burden: *J. L. Nicholson*. Quality milk: *R. S. G. Rutherford*. Clothing shops in the United Kingdom: *G. D. N. Worswick*.

Vol. 6, No. 11—Expenditure on rent: *J. Goldmann*. Private profits and extra-Budgetary Revenue: *A. M. de Neuman*. The importance of multilateral trade for Britain: *T. Balogh*. Wages and cost of living sliding scales: *J. L. Nicholson*.

Vol. 6, No. 12—Post-war employment in the U.S.A.: *J. Steindl*. Economics of pre-fabrication: *S. Moos*.

Vol. 6, No. 13—The statistical background of clothes rationing: *P. Ady*. Changes in consumption, 1938–43: *J. L. Nicholson*.

INDIA—

Indian Journal of Economics—

April 1944—Economic controls in India during the war (12 papers). Regulation of banking in India (3 papers). Recent changes in the capitalistic economy (8 papers).

July 1944—Post-war implications of India sterling credits: *B. N. Bhojwani*. The future of gold vis-à-vis currency plans: *K. Zalwani*. Post-war economic planning in India: *K. Iyengar*. War and recent trends in India's foreign trade (I): *A. Seshgiri Rao*.

UNITED STATES—

Harvard Business Review—

Summer Number 1944—Economic proposals for the Peace settlement: *A. R. Upgren*. Materials management in the Airframe industry: *H. T. Lewis* and *C. A. Livesey*. Economics of air transportation: *John B. Crane*. World transport aviation: *J. B. Hubbard*.

Journal of Political Economy—

June 1944—Rivals and interlopers in the history of the New York security market: *George Garvy*. Development of the pump-priming theory: *Clay J. Anderson*. Use of data collected by poorly trained enumerators: *H. P. Hartkemeier*.

Quarterly Journal of Economics—

May 1944—Limits to the use of capital: *D. McC. Wright*. Proportional income taxation and risk bearing: *E. D. Domar* and *R. Musgrave*. The cost of a "Beveridge Plan" in the United States: *L. R. Klein*. Equalization schemes in German unemployment compensation: *G. F. Rohrlach*.

August 1944—War-time economic controls: *E. Ronald Walker*. International commodity arrangements: *J. D. Black* and *S. S. Tsou*. Pareto on population, I: *J. J. Spengler*. German foreign trade and industry after the first world war: *Nehemiah Robinson*.

Review of Economic Statistics—

May 1944—Manpower and employment problems in transition from war to peace: *William Haber*. Operations of the American Exchange Stabilization Fund: *A. I. Bloomfield*. Life insurance saving of American families: *G. S. Fulcher*.

FRANCE—

Société de Statistique de Paris, Journal—

Jan.-fevr. 1943—Les statistiques industrielles dans le cadre de la nouvelle organisation économique: *F. Chapel*. Réflexions psychologiques sur les notions de probabilité et de hasard et sur quelques notions connexes: *Marcel Prot*. L'influence du mouvement de la population sur le développement économique: *J. Bourdon*.

Mars-avril 1943—Sur une expression simple approchée de la loi de probabilité des erreurs d'observation: *Maurice Fréchet*.

Sept.-oct. 1943—Les statistiques houillères: *M. Gruner*. Chronique de démographie: *Paul Gasc*. La circulation de la monnaie et le niveau des prix (1^{re} partie): *Georges Létinier*.

Nov.-dec. 1943—Définitions de l'inégalité des revenus et utilisation de la formule de Pareto: *le baron Mourre*. La circulation de la monnaie et le niveau des prix (2^e partie): *Georges Létinier*. Analyse et réfutation de la théorie de valeur de Karl Marx: *René Pupin*.

Jan.-fevr. 1944—Monnaies, salaires et prix à travers l'histoire: *L. de Riedmatten*. La circulation de la monnaie et le niveau des prix (3^e partie): *Georges Létinier*.

Mars-avril 1944—L'évolution de l'agriculture française métropolitaine à travers l'histoire: *Paul Razous*. Principales lacunes et insuffisances des statistiques françaises: *Michel Huber*.

Mai-juin 1944—Sur les méthodes de prévision en démographie: *Alfred Sauvy*. Les mouvements des prix de 1661 à 1715 et leurs répercussions: *Jean Meuvret*. Chronique des statistiques bancaires et ses questions monétaires: *Pierre Cauboue*. La dérivation des revenus et ses risques économiques: *Jean Dayre*. Théorie des choix: *René Roy*.

MEXICO—

Estadística—

June 1944—Statistical functions of business organisations in the United States: *Stuart A. Rice*. O recenseamento de 1940 do ponto de vista da técnica censitária: *O. A. de Moraes*. Nota acerca del ajustamiento mecánico: *E. Michalup*. La longevidad rural comparada con la urbana: *T. N. E. Greville*. Agricultural census of Paraguay: *Wm. C. Brister*.

INTERNATIONAL—

International Labour Review—

July 1944—Twenty-sixth session of the International Labour Conference, April-May 1944. The employment of prisoners of war in the United States: *Major M. S. McKnight*. Net wages and real wages in Germany: *René Livchen*.

August 1944—Employment of negroes in United States war industries: *R. C. Weaver*. Social security for housewives: *Emmy Freundlich*. Employment policy in Great Britain: the Government's White Paper. Danish social policy in wartime.

LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part IV, 1943, the Society has received the publications enumerated below:—

I.—OFFICIAL PUBLICATIONS

(a) United Kingdom.

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REVENUE OF THE UNITED KINGDOM

*Net Produce in Quarters of 1943, and in Financial Years ended
March 31, 1943-44, 1942-43, 1941-42, 1940-41*

(000's omitted)

QUARTERS, ended	March 31, 1943	June 30, 1943	Sept. 30, 1943	Dec. 31, 1943	Total for Calendar Year 1943
	£	£	£	£	£
Customs	116,060	129,360	130,783	141,119	528,321
Excise	108,200	111,000	123,600	123,795	466,595
Stamps and Estate etc. Duties	29,274	27,692	29,189	28,765	114,890
Other Inland Revenue Duties	630	120	108	20	878
Post Office	25,750	26,500	26,030	28,350	108,050
Wireless Licences	1,470	830	860	1,500	4,660
National Defence Contribution	10,150	5,100	8,204	9,608	33,128
Excess Profits Tax	93,857	86,077	142,276	127,466	449,676
	385,391	386,745	467,989	461,123	1,701,198
Income Tax and Surtax	653,434	102,876	208,968	162,702	1,187,970
	1,038,825	549,621	676,997	623,825	2,889,168
Motor Vehicle Duties	22,040	1,838	1,873	1,749	27,500
Crown Lands	280	240	230	260	1,010
Interest on Sundry Loans	1,004	807	1,126	2,549	6,146
Miscellaneous Receipts	13,027	13,157	26,484	18,948	72,316
	1,076,376	565,723	706,610	647,331	2,996,040

YEARS, ended March 31	1943-44	1942-43	1943-44 (compared with 1942-43)		Corresponding Years	
			Increase	Decrease	1941-42	1940-41
	£	£	£	£	£	£
Customs	560,832	459,489	101,343	—	378,361	304,989
Excise	482,200	423,300	58,900	—	325,690	224,100
Stamps and Estate etc. Duties	117,206	108,616	8,590	—	106,003	94,456
Other Inland Revenue Duties	968	950	18	—	902	1,015
Post Office	111,000	114,800	—	3,800	111,290	101,740
Wireless Licences	4,750	4,500	190	—	—	—
National Defence Contribution	33,446	30,635	2,811	—	21,883	24,083
Excess Profits Tax	466,668	346,887	119,781	—	217,160	72,103
	1,777,070	1,491,337	285,633	3,900	1,198,209	822,437
Income Tax and Supertax	1,269,625	1,082,180	177,439	—	844,394	600,056
	3,036,695	2,573,523	289,633	3,900	2,037,803	1,422,493
Motor Vehicle Duties	27,291	28,537	—	1,246	38,422	38,006
Canadian Government Contribution	—	224,719	—	224,719	—	—
Crown Lands	1,060	1,000	60	—	950	1,100
Interest on Sundry Loans	6,455	4,061	2,394	—	5,234	2,553
Miscellaneous Receipts	77,876	90,333	—	12,457	92,230	31,132
	3,149,180	2,922,373	469,596	212,719	2,174,639	1,495,284
Total			Net Incr. 226,807			

BANK OF ENGLAND
Pursuant to the Act 7th and 8th Victoria, cap. 32 (1844),
 (000's omitted)

1	2	3	4	5	6	7	8
ISSUE DEPARTMENT						COLLATERAL COLUMNS	
Liabilities	DATES	Assets				Notes in Hands of Public	Minimum Discount Rate
Notes Issued	(Wednesdays)	Govt. Debt (£11,013) and Govt. Securities	Other Securities	Gold Coin and Bullion	Silver Coin		
£		£	£	£	£	£	Per cent.
950,212	Jan. 6.....	943,435	804	219	761	920,025	2
950,212	" 13.....	948,300	840	242	761	914,098	(26.10.30)
950,242	" 20.....	948,560	927	242	513	909,380	
950,242	" 27.....	948,573	914	242	513	908,060	
950,242	Feb. 3.....	918,917	1,072	242	11	911,285	
950,242	" 10.....	919,239	733	242	8	913,979	
950,242	" 17.....	919,103	798	212	9	914,911	
950,242	" 24.....	940,248	789	242	13	917,447	
950,242	Mar. 3.....	949,288	700	242	12	922,467	
950,242	" 10.....	949,291	700	212	9	926,350	
950,242	" 17.....	949,185	802	212	13	927,383	
950,242	" 24.....	949,090	892	212	9	928,717	
950,242	" 31.....	949,095	892	242	13	934,532	
950,212	Apr. 7.....	949,118	873	242	9	939,511	
1,000,242	" 14.....	999,024	963	212	13	943,494	
1,000,212	" 21.....	999,123	867	212	10	947,852	
1,000,242	" 29.....	999,092	895	242	13	953,412	
1,000,242	May 5.....	999,110	880	242	10	953,937	
1,000,242	" 12.....	999,085	955	242	10	951,591	
1,000,242	" 19.....	999,168	621	242	11	947,306	
1,000,242	" 26.....	999,118	800	212	12	944,970	
1,000,242	June 2.....	999,190	795	242	15	946,435	
1,000,242	" 9.....	999,188	882	242	10	946,837	
1,000,242	" 16.....	999,242	749	242	9	949,426	
1,000,242	" 23.....	999,161	828	242	11	947,743	
1,000,242	" 30.....	999,199	839	212	12	946,341	
1,000,242	July 7.....	999,116	874	212	10	949,586	
1,000,242	" 14.....	999,215	775	212	9	952,924	
1,000,242	" 21.....	999,274	717	212	9	955,980	
1,000,242	" 28.....	999,333	639	212	8	968,116	
1,000,242	Aug. 4.....	999,232	737	212	11	978,111	
1,000,242	" 11.....	999,323	662	212	15	974,707	
1,000,242	" 18.....	999,322	666	212	12	976,983	
1,000,242	" 25.....	999,235	739	212	16	971,933	
1,000,242	Sept. 1.....	999,244	708	212	8	978,713	
1,000,242	" 8.....	999,305	682	212	12	980,781	
1,000,242	" 15.....	999,308	781	212	11	981,080	
1,000,242	" 22.....	999,259	720	212	12	980,700	
1,000,242	" 29.....	999,309	681	212	17	986,405	
1,050,242	Oct. 6.....	1,049,200	782	242	13	991,260	
1,050,242	" 13.....	1,049,109	875	242	16	992,731	
1,050,242	" 20.....	1,049,134	855	242	11	993,430	
1,050,242	" 27.....	1,049,155	831	242	14	998,462	
1,050,242	Nov. 3.....	1,049,185	803	242	12	1,005,063	
1,050,242	" 10.....	1,049,127	856	242	17	1,010,861	
1,050,242	" 17.....	1,049,112	878	242	10	1,013,682	
1,050,242	" 24.....	1,049,173	819	212	8	1,019,047	
1,050,242	Dec. 1.....	1,049,283	707	242	10	1,049,283	
1,100,242	" 8.....	1,099,268	718	242	14	1,099,268	
1,100,242	" 15.....	1,099,383	655	242	12	1,099,333	
1,100,242	" 22.....	1,099,253	733	242	12	1,099,255	
1,100,242	" 29.....	1,099,304	686	242	10	1,098,662	

WEEKLY RETURN

for Wednesday in each Week, during the Year 1943

(000's omitted)

9	10	11	12	13	14	15	16	17	18
BANKING DEPARTMENT									
Liabilities				DATES (Wednes- days)	Assets				Totals of Liabilities and Assets
Capital (£14,533) and Rest	Public Deposits	Bankers' Deposits	Other Deposits		Govt. Secur- ities	Dis- counts and Ad- vances	Other Secur- ities	Reserve (Notes and Coin)	
£	£	£	£	Jan. 6	£	£	£	£	£
17,882	7,273	157,625	83,492	" 13	197,358	16,725	20,416	30,777	265,272
17,902	9,739	146,285	66,621	" 20	171,078	11,063	21,704	36,655	240,497
17,920	9,507	166,577	63,320	" 27	190,488	4,742	20,592	41,522	257,324
17,942	4,745	175,867	56,576	Feb. 3	188,278	4,384	24,734	42,724	255,120
17,950	8,141	139,512	58,076	" 10	158,168	4,449	21,150	39,913	223,679
17,972	8,035	142,580	56,005	" 17	163,943	4,487	19,059	37,113	224,602
17,989	6,612	149,475	59,360	" 24	173,933	4,106	19,200	36,196	233,436
18,003	7,054	178,233	53,927	Mar. 3	199,183	5,069	19,313	33,643	257,217
18,021	6,860	164,902	57,654	" 10	186,568	4,626	27,621	28,622	247,437
18,037	4,713	100,390	51,291	" 17	188,588	4,075	19,226	24,973	237,461
18,052	6,863	156,061	53,745	" 24	187,358	4,121	19,120	24,125	234,724
18,064	5,966	169,557	55,217	" 31	199,238	6,524	19,869	22,873	248,804
18,079	5,923	141,343	56,551	Apr. 7	171,173	9,857	27,274	16,871	225,178
17,631	1,835	144,511	55,231	" 14	181,993	9,635	18,837	11,766	222,231
17,665	17,786	151,878	51,177	" 21	139,643	5,681	18,422	57,700	221,506
17,683	6,187	141,383	53,631	" 28	141,133	4,827	19,347	53,282	218,889
17,697	8,343	170,109	53,063	May 5	171,143	6,291	22,016	47,763	249,233
17,712	3,733	162,092	52,708	" 12	162,898	5,187	20,975	47,165	236,245
17,721	20,740	140,088	51,172	" 19	161,783	4,537	16,869	49,533	232,722
17,738	18,374	140,689	51,063	" 26	153,743	4,344	15,987	53,790	227,864
17,755	3,249	174,067	50,969	June 2	171,038	4,607	14,243	56,152	246,040
17,773	17,268	140,306	51,914	" 9	150,818	4,950	16,757	54,727	227,261
17,791	14,456	143,627	52,548	" 16	132,833	4,711	16,614	54,204	226,422
17,812	7,170	167,608	53,282	" 23	163,363	4,207	16,652	51,710	235,932
17,834	7,270	148,910	54,104	" 30	153,748	5,040	15,937	53,493	228,178
17,847	9,573	238,062	55,269	July 7	233,418	4,912	27,546	54,815	320,691
17,871	7,911	161,329	52,591	" 14	166,948	1,331	16,832	51,594	239,705
17,885	5,299	146,367	51,142	" 21	151,503	3,966	16,957	48,267	223,693
17,891	6,356	147,363	76,777	" 28	180,793	4,695	16,617	45,275	247,380
17,914	6,624	169,937	51,607	Aug. 4	180,399	7,268	27,964	33,431	249,582
17,931	5,347	148,633	53,615	" 11	183,161	1,254	17,709	23,428	225,559
17,938	4,524	140,269	55,060	" 18	180,019	711	15,732	21,895	218,387
17,980	6,782	119,507	56,781	" 25	187,108	1,771	15,906	24,065	229,450
17,997	7,150	166,707	56,591	Sept. 1	202,028	3,430	16,318	26,729	248,505
18,016	11,299	155,994	53,190	" 8	195,701	2,063	17,485	22,917	238,769
18,027	14,333	140,371	53,180	" 15	181,051	2,392	17,650	20,813	225,919
18,043	9,020	151,214	55,013	" 22	155,561	2,118	17,475	20,841	236,290
18,067	7,204	161,365	53,118	" 29	203,782	879	16,650	21,593	242,784
18,093	9,337	173,425	55,119	Oct. 6	200,657	1,890	29,021	16,430	256,004
17,685	7,821	150,237	55,230	" 13	152,177	1,935	16,242	60,698	230,682
17,693	7,451	118,360	51,738	" 20	150,827	1,355	16,952	59,149	228,263
17,697	23,610	140,690	54,061	" 27	158,782	1,433	17,319	58,533	236,086
17,705	5,378	104,324	53,078	Nov. 3	186,862	1,576	24,450	53,577	256,485
17,708	6,137	132,809	52,476	" 10	163,282	1,002	17,944	46,912	229,140
17,730	9,640	156,919	52,245	" 17	176,807	1,287	17,377	41,083	235,564
17,741	8,521	147,849	52,715	" 24	170,172	1,244	16,627	38,283	226,326
17,767	6,753	183,168	53,254	Dec. 1	205,137	6,974	16,950	32,881	260,942
17,787	12,908	168,040	57,561	" 8	204,287	6,127	24,879	31,063	256,296
17,806	6,272	154,810	52,673	" 15	150,612	8,177	16,101	56,873	231,263
17,820	8,997	161,753	55,693	" 22	191,147	1,982	15,996	34,463	243,587
17,843	7,325	189,039	53,743	" 29	210,305	1,618	15,769	20,258	247,950
17,860	10,338	234,274	60,856	" 30	291,965	2,473	15,916	12,474	322,828

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JOURNAL OF THE ROYAL STATISTICAL SOCIETY

PART II, 1944.

THE SELECTION OF INDUSTRIES SUITABLE FOR DISPERSION INTO RURAL AREAS

By P. SARGANT FLORENCE *

[Read before THE ROYAL STATISTICAL SOCIETY, April 18th, 1944, the PRESIDENT,
DR. E. C. SNOW, C.B.E., in the Chair.]

§ 1. *Principles of selection*

IN the majority of country planning schemes land is likely to be reserved for agriculture and recreation and land marked off that is unfit for manufacturing industry owing to such factors as poor transport facilities and unsuitable relief. After this process of "sieving," the remaining areas may be taken as open for manufactures. The problem then arises which of many possible particular manufacturing industries are the most advantageous for such areas.

In selecting and controlling particular industries suitable for dispersion into rural areas three guiding principles must be observed.

The first principle is that the industries which are encouraged should fit in and balance with the existing economic structure of the area. In this paper we are dealing with the predominantly agricultural and residential economy of most English rural areas. Industries desirable, for this reason, should "balance" and make up for the fact that agriculture employs a disproportionate number of men and of older workers; † that it offers less employment in winter; and that, if pre-war trends continue, the total employed may fall. If, as is quite probable, there is a fall in the demand for female domestic service from well-to-do residents, this is an additional reason for admitting industries offering employment to women.

The second principle is that industries to be selected should be such as to be of advantage to the *national* policy for solving unemployment, urban congestion and other social problems. Except for a *probable* decline in domestic service and a *possible* decline in agricultural activity from the war-time peak (under the assumption that agriculture is not specially stimulated), rural areas do not on the whole constitute problem areas. They did not suffer before the war any extreme unemployment; nor in most areas is the population engaged to such an extent in manufacturing for war purposes that industrial demobilization from a war and conversion to a peace basis is likely to present any acute difficulties. But suitable rural areas must each bear their share of national plans for dispersion of industry from congested urban areas if, as we assume, the recommendations

* Assisted by Clive Williams, with endowment from the West Midland Group for Post-War Reconstruction and Planning.

† In farming the proportion of women to total occupied was in 1931 6 per cent. as against 30 per cent. for all industries. In farming the age groups 14-17, 18-29, 30-59 and 60 and over, formed 9 per cent., 27 per cent., 47 per cent. and 16 per cent. of all occupied as against 10 per cent., 34 per cent., 48 per cent. and 8 per cent. of those occupied in all industries.

of the Barlow Commission and the Scott Committee are to be implemented after the war. This does not mean that factories hitherto operating in London or the West Midland conurbation will be uprooted and "moved" into the country, but simply that new factories, or possibly extensions to factories that it is proposed should start in certain industries, will be encouraged to start in rural areas and discouraged from starting in the congested areas. If the recommendations of the Commissioner of the English and Welsh Special Areas are followed, this discouragement from the London area may amount to an absolute veto.*

When dispersing from congested areas it is a further advantage if factories do not give rise to fumes or effluents that would spoil the country or foul its streams; and if factories would gain from a country location. Thus country air may favour clean production of foodstuffs and form a legitimate marketing asset. Dispersed factories must not be so large as to entail too much new house-building, or too long a journey to and from work for scattered workers. Finally, dispersed factories, being isolated units, should not be liable to cyclical depression from which their workers could not escape to factories in other industries.

The third principle is one of practical feasibility, not social desirability. It is simply that the industries encouraged should not operate under costs that are high compared to the costs of their competitors or compared to the demand prices of their customers. Factories in many industries cannot economically be dispersed at will, either because (a) they must be near concentrated natural supplies or final markets (*i.e.*, are "rooted"), or near some other industry providing supplies or markets (*i.e.*, are "linked"); or (b) because they are already fully dispersed among the population (*i.e.*, are "residential"); or (c) because special facilities and services, including skilled labour and advice shared in common, make a common habitat with other plants of the same industry economical (*i.e.*, the industry is for economic reasons centred or "clustered"). Dispersion in agricultural areas is practicable, however, where the "roots" or "links" of the industry are agricultural supplies or an agricultural demand; or else where the industry is "footloose" in the sense that it is neither rooted nor linked, residential nor necessarily centred.

Thanks to the Census of Production, the Census of Population and returns of the Ministry of Labour, it is possible, as in Table A, to give specific industries a quantitative measure on the score of most of the qualities required by the three principles of dispersion. The figures from these official sources all date from before the outbreak of war, and some abrupt changes have occurred since the data were collected, such as the application of machinery to agriculture. The qualities measured, however, depend largely on long-term technical and economic considerations, and in many respects (*e.g.*, consumer demands, employment of married women) the position after the war is likely to "regress" to the pre-war situation.

Unfortunately, it is not possible to obtain all the required information from one source with a single system of classified industries subdividing the country into regions. The precise source from which, and the formula by which, the statistical measures are reached are given in the headings and notes to Table A and in the Appendix.

Subject to reference to these notes, a summary is here presented of the qualities, quantitatively measurable, asked of a dispersible industry. The numerical criteria suggested in this list are developed further in the next section.

* Third Report, 1936, Cmd. 5303, pp. 7-9.

Summary of the Qualities which the three Principles of Dispersion ask of any industry

I. *Desirable Qualities to Balance with Agricultural Economy*

- Employment of women—say 30 per cent. or over of total employment.
- Employment of young persons more than average.
- Relative *winter* activity.
- Growing total numbers employed.

II. *Desirable Qualities for Dispersal*

1. Industries disproportionately in congested area—e.g., London location quotient * over 1.0.
2. No noxious fumes or effluents specially damaging to the country.
3. Special advantage of country location for production and management.
4. Prevailing size of plants not very large, say employing less than 200.
5. Relative immunity from trade cycle.

III. *Practical Feasibility*

1. Economic linkage with Agriculture.
Coefficient of linkage * above 0.45—with some probable economic explanation.
2. Local concentration of plants economically unnecessary.
Coefficient of localization, * say, 0.45 or less.
3. Dispersion parallel to population not already established (*i.e.*, not residuary).
Coefficient of localization, * say, more than 0.20.
4. Industry not heavy and rooted. Horse-power in use per worker not more than 1.0.

§ 2. *Assessment of dispersion factors of selected industries*

The degree to which certain industries possess the qualities asked for by dispersion is measured in Table A. The industries that are listed are a provisional selection of those that appear most suitable for rural dispersion. But it must be realized that the selection is limited by the available data. The sources of the data are the Census of Population, the Census of Production and the unemployment and insured population returns of the Ministry of Labour.

Table A: Columns 1, 2 and 3

The industries are named according to the Census of Population (Industry Tables) definition, since for all industries listed data are obtainable from this Census. But this Census does not give sufficient information on all the tests required. In columns 6 and 8 data must be used from the Ministry of Labour employment returns published in the *Labour Gazette* and in columns 7, 10, 13a and 14 use is made of the Census of Production of 1930 and 1935. Unfortunately, each of these three sources of information, though all of them official, uses a different system of classifying industries. Sometimes, as column 3 shows, data are not available from the Census of Production or the Ministry of Labour.

* These technical measures are defined and explained in the Appendix.

TABLE AA

List of Industries Provisionally selected as Suitable for Rural Dispersion

Census of Population Titles (Table A, Cols. 1, 2, 4, 5, 9, 12, 13b)	Census of Production Titles (Table A, Cols. 7, 10, 13a, 11)	Ministry of Labour Titles (Table A, Cols. 6, 8)
METAL INDUSTRIES		
1. Agricultural Engineering (153).	Agricultural Machinery.	✓ (part of General Engineering).
2. Carriages, Coach and Car Bodies, Carts and Vans, Lorry Bodies; and Wheelwrighting (187/4).	Carriage, Cart and Wagon.	Carriages, Coaches, Lories, Carts, etc.
3. Constructional Engineering; Bridge and Girder Works (227).	Constructional Engineering.	Constructional Engineering, Bridge and Girder Work.
4. Electrical Cables and Apparatus (171-5 and 178) including: (a) Accumulators and Batteries (173). (b) Other Electrical Manufactures (178).	Electrical Engineering <i>minus</i> Machinery (a) Primary Batteries and Accumulators. (b) Lighting Accessories and Fittings and Heating and Cooking Apparatus.	Electric Cables, Wire and Flex, Electric Apparatus, Lamps and other Electrical Manufactures (not Electrical Engineering). (a) *. (b) *.
5. Heating and Ventilating Engineering (156).	× (part of Mechanical Engineering).	Heating and Ventilating Apparatus.
6. Tin Boxes, Canisters and Containers (241).	Tin Boxes.	✓ (part of Metal Industries not separately specified).
FOOD AND DRINK INDUSTRIES		
7. Bacon, Hams, Lard and Sausages (370).	Bacon Curing and Sausages.	Food Industries not separately specified.
8. Biscuits (265).	Biscuit Trade.	Bread, Biscuit, Cake, etc.†
9. Butter, Cheese, Condensed and Dried Milk (373).	Butter, Cheese, Condensed Milk and Margarine.	Food Industries not separately specified.
10. Cattle and Poultry Foods (not Oil Cake) (362).	Cattle, Dog and Poultry Foods.†	Food Industries not separately specified.
11. Grain Milling (360).	Grain Milling.	Grain Milling.
12. Jam-making and Fruit Preserving (368).	Preserved Foods.†	Food Industries not separately specified.
13. Mineral and Aerated Waters; Cider and Perry (383; 384).	Aerated Waters, Cider, Vinegar and British Wines.†	× (part of Drink Industries).
14. Sugar Confectionery (Sweets); Cocoa and Chocolate (367; 380).	Cocoa and Sugar Confectionery.	Cocoa, Chocolate and Sugar Confectionery.
15. Sugar Making and Refining (including Glucose and Invert Sugar) (366).	Sugar and Glucose.	Food Industries not separately specified.
OTHER INDUSTRIES		
16. Boots, Shoes, Slippers (not rubber); Clogs (363; 354).	Boot and Shoe Trade.	Boot, Shoe, Slipper and Clog Trades.
17. Bricks and Unglazed Tiles; Firebricks and Fireclay Goods (000).	Brick and Fire Clay.	Bricks, Pipes, Unglazed Tiles and Fireclay Goods.
18. Brooms and Brushes (405).	Brush Trade.	Brush and Broom.
19. Cabinet and Furniture Making and Upholstering (410).	Furniture and Upholstery.	Furniture, Upholstery, House and Shop Fittings, etc.
20. Canvas Goods (Tents, Tarpaulins, etc.) (318).	Canvas Goods and Sack Trades.	× (part of Textiles not separately specified).
21. Celluloid and Similar Compositions (493).	Fancy Articles.‡	× (part of Industry not separately specified).
22. Furs, Skins, Leather (330/3).	Leather (Tanning and Dressing).	Tanning, Currying and Leather Dressing, Fellingmongering, Furs. × (part of Chemicals).
23. Fertilizers, Sheep Dips and Disinfectants (074).	Fertilizer, Disinfectant, Glue, etc.	
24. Paper and Board Making, Coating, Enamelling (430).	Paper and Board.	Paper and Paper Board Making, Paper Coating and Enamelling.
25. Printing, Bookbinding and Photography (including Newspapers) (440, 6 and 459).	Printing, Bookbinding, Stereotyping, Engraving, etc., Printing and Publication of News.	Printing, Publishing, Bookbinding and Photography.
26. Rope, Cord, Twine (313).	Rope, Twine and Net.	Hemp Spinning and Weaving, Rope, Cord, Twine, etc.
27. Saddlery, Harness, Bags, Trunks and Other Goods of Leather and Substitute (336-339).	Saddlery, Harness and Leather Goods.	Saddlery, Harness and Other Leather Goods.
28. Saw Mills and Joinery Works (400).	Timber (Sawmilling, etc.)†	Sawmilling and Machine Woodworking.
29. Toys, Games and Sports Requisites (499).	Games and Toys; Sports Requisites.	Toys, Games and Sports Requisites.
30. White Lead and Lead Compounds; Paints, Colours and Varnish (090; 091).	Paint, Colour and Varnish.	Paints, Varnish, Japan, Red and White Lead.

× Not available.

* Not available separately.

† Covers somewhat wider field of production than Census of Population.

‡ Excludes making materials, includes additional final products, e.g., buttons.

TABLE A
Analysis of Factors in the Location of Industries in Agricultural Areas

CAPACITY OF INDUSTRIES TO BALANCE AN AGRICULTURAL ECONOMY															ADVANTAGES AND DISADVANTAGES FOR NATIONAL POLICY OF DIVERSIFICATION					PRACTICAL FEASIBILITY.				
Number Occupied in each Industry in Great Britain, Census of 1981	Source of Figures: if CROD, then POP, and the Ministry of Labour	Proportion of women employed in the industry (per cent.)	Age Structure of Occupied in England and Wales	Seasonal Fluctuations in the U.K. (if irregular, then not conspicuous). Some are estimated or known from discussions with industrialists	Growth in the U.K. Percent. age Drop in Employment, 1981 to 1984	Location in Competed Regions		Other Advantages or Disadvantages of Country Location	Likewise with Architecture		Degree of "Localisation"	Home-power (Operative)												
						Amplitude Trade Cycle (U.K.)	Location in Competed Regions		Probable Explanation	Probable Explanation														
3	5	4	6	7	8	9a	9b	10	11	12a	12b	13a	13b	14										
INDUSTRIES																								
Arranged alphabetically, according to the Census of Population description; the Census Code Numbers being in brackets																								
Source of Each Column's Figures (Symbols, see Col. 3)																								
1. Agricultural Engineering (188)	18,198	5	Y.J.A.V.	REG. Oct.-Mar. (1981)	10.1	0.1	L.S.	1		0.72	0.41	0.88	1.1 (29)											
2. Carriages, Carts and Vans (187/8)	40,071	4	Y.J.A.V.	REG. Spring-Summer (1981)	119.3 (2)	1.1	L.S.	1		0.72	0.41	0.88	0.8 (29)											
3. Constructional Engineering (297)	45,474	3	Y.J.A.V.	REG. Spring-Summer (1981)	69.5	1.1	L.S.D.	1		0.37	0.34	0.80	0.8 (29)											
4. Electrical Apparatus and Instruments (171-4)	191,908	23	Y.J.A.V.	REG. Nov.-Dec. (1981)	10.1	1.1	L.S.D.	1		0.37	0.34	0.80	0.8 (29)											
5. Other Electrical Machinery (171-4)	71,845	26	Y.J.A.V.	REG. Nov.-Dec. (1981)	10.1	1.1	L.S.D.	1		0.37	0.34	0.80	0.8 (29)											
6. Textiles (179)	18,635	7	Y.J.A.V.	REG. (Aug.-Dec.) (1981)	260.0 (2)	1.8	L.S.	1		0.48	0.31	0.81	0.8 (29)											
7. Tins, Cans and Containers (241)	20,082	68	Y.J.A.V.	REG. (Aug.-Dec.) (1981)	260.0 (2)	1.8	L.S.	1		0.48	0.31	0.81	0.8 (29)											
FOOD AND DRINK INDUSTRIES																								
8. Bacon, Ham, Lard and Sausages (370)	8,977	27	Y.J.A.V.	REG. (Oct.-Jan.) (1981)	54.7	0.8 (2)	L.S. Imp.	1		0.44 (2)	0.41	0.81	0.8 (2)											
9. Biscuits (469)	40,725	20	Y.J.A.V.	REG. (Summer) (1981)	88.8 (2)	0.8 (2)	L.S. Imp.	1		0.44 (2)	0.41	0.81	0.8 (2)											
10. Cakes and Pastry (469)	6,248	19	Y.J.A.V.	REG. (Summer) (1981)	72.6	0.8 (2)	L.S. Imp.	1		0.44 (2)	0.41	0.81	0.8 (2)											
11. Confectionery (469)	40,817	20	Y.J.A.V.	REG. (Summer) (1981)	72.6	0.8 (2)	L.S. Imp.	1		0.44 (2)	0.41	0.81	0.8 (2)											
12. Cereals and Grain-milling (286)	22,815	88	Y.J.A.V.	REG. (July-Sept.) (1981)	94.0 (2)	1.8 (2)	L.S. Imp.	1		0.44 (2)	0.41	0.81	0.8 (2)											
13. Dairies (286)	22,815	88	Y.J.A.V.	REG. (July-Sept.) (1981)	94.0 (2)	1.8 (2)	L.S. Imp.	1		0.44 (2)	0.41	0.81	0.8 (2)											
14. Meat and Meat Products (286)	22,815	88	Y.J.A.V.	REG. (July-Sept.) (1981)	94.0 (2)	1.8 (2)	L.S. Imp.	1		0.44 (2)	0.41	0.81	0.8 (2)											
15. Sugar Confectionery (286)	22,815	88	Y.J.A.V.	REG. (July-Sept.) (1981)	94.0 (2)	1.8 (2)	L.S. Imp.	1		0.44 (2)	0.41	0.81	0.8 (2)											
16. Super-milling and Refining (466)	21,147	18	Y.J.A.V.	REG. (Sept.-Jan.) (1981)	20.1	1.8	S. Imp.	1		0.44	0.31	0.81	0.8 (29)											
OTHER INDUSTRIES																								
17. Books, Sheet Silvers, Glass (383; 344)	218,235	27	Y.J.A.V.	REG. Mar.-May; Sept.-Nov. (1981)	10.7	0.8	L.S. Imp.	1		0.50	0.41	0.81	0.8 (29)											
18. Bottles and Jars (383; 344)	17,188	29	Y.J.A.V.	REG. (Mar.-May; Sept.-Nov.) (1981)	10.7	0.8	L.S. Imp.	1		0.50	0.41	0.81	0.8 (29)											
19. Candles and Tapers (383; 344)	16,988	29	Y.J.A.V.	REG. (Mar.-May; Sept.-Nov.) (1981)	10.7	0.8	L.S. Imp.	1		0.50	0.41	0.81	0.8 (29)											
20. Ceramics and Pottery (383; 344)	16,988	29	Y.J.A.V.	REG. (Mar.-May; Sept.-Nov.) (1981)	10.7	0.8	L.S. Imp.	1		0.50	0.41	0.81	0.8 (29)											
21. Coloured and Similar Compositions (483)	16,988	29	Y.J.A.V.	REG. (Mar.-May; Sept.-Nov.) (1981)	10.7	0.8	L.S. Imp.	1		0.50	0.41	0.81	0.8 (29)											
22. Embroidery, Sewing																								

(1) Not available.

(1) Not available.
(2) Not available.
(3) Figures are from 1988 Census of Production.
(4) Not available separately.
(5) Not available separately.

(1) Not available.

(1) Not available.
(2) Not available separately.
(3) Estimated on basis of 1988 Census of Food-Drugs.
(4) Estimated on basis of 1988 Census of Food-Drugs.
(5) Estimated on basis of 1988 Census of Food-Drugs.

(*) Estimated on basis of
 (†) Estimated from 1988 Census of Production
 (‡) Not available separately.
 (§) Estimated on basis of

(1) Not available.
(2) Not available.
(3) Estimated on basis of knowledge.

(*) Estimated on basis of knowledge of individual.

(†) Estimate from Department of Education

(1) Not available.
(2) Figures are from 1988 Census of Dendroctonus.
(3) Not available separately.
(4) Estimated on basis of knowledge of industries in

(*) Not available.

(†) Estimated on basis of knowledge of industries in question.

(‡) Figures are from 1978 Census of Production

(*) Not available.
(1) Not available separately.
(2) Estimated on basis of knowledge of industries in question.

(1) Not available.
(2) Figures are from 1928 Census of Densification.
(3) Not available separately.
(4) Estimated on basis of knowledge of industries in question.
(5) Figures are from 1928 Census of Densification.

(*) Not available.
 (†) Figures are from 1988 Census of Occupations
 (‡) Estimates are from 1988 Census of Occupations
 (¶) Figures are from 1988 Census of Occupations
 (•) Estimated on basis of knowledge of industries in question.
 (e) Figures are from 1988 Census of Occupations

(1) Not available.
(2) Figures are from 1958 Census of Occupations.
(3) Not available separately.
(4) Estimated on basis of knowledge of industries in question.
(5) Figures are from Ministry of Labour.

(1) Not available.
(2) Figures are from 1958 Census of Occupations.
(3) Not available separately.
(4) Estimated on basis of knowledge of industries in question.
(5) Figures are from Ministry of Labour.

(a) Not available.
(b) Not available.
(c) Estimated on basis of knowledge of industries in question.
(d) Figures are from Ministry of Labour and
(e) Figures are from Ministry of Labour and

(1) Not available.
(2) Figures are from 1958 Census of Occupations.
(3) Estimated on basis of knowledge of industries in question.
(4) Figures are from Ministry of Labour and measure the

(1) Not available.
 (2) Figures are from 1985 Census of Occupations.
 (3) Estimated on basis of knowledge of industries in question.
 (4) Figures are from Ministry of Labour and measure the growth of
 (5) Figures are from Ministry of Labour and measure the growth of

(a) Figures are from Ministry of Labour and measure the growth of employment.
(b) Estimated on basis of knowledge of industries in question.
(c) Estimated on basis of knowledge of industries in question.
(d) Not available.
(e) Not available.
(f) Not available.
(g) Not available.
(h) Not available.
(i) Not available.
(j) Not available.
(k) Not available.
(l) Not available.
(m) Not available.
(n) Not available.
(o) Not available.
(p) Not available.
(q) Not available.
(r) Not available.
(s) Not available.
(t) Not available.
(u) Not available.
(v) Not available.
(w) Not available.
(x) Not available.
(y) Not available.
(z) Not available.

(4) Figures are from Ministry of Labour and measure the growth of employment from 1955 to 1965.

(c) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1938.

(4) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1948.

(1) Not available.
(2) Not available.
(3) Estimated on basis of knowledge of industries in question.
(4) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1948.
(5) Figures are from 1938 Census of Occupations.
(6) Figures are from 1938 Census of Occupations.

(a) Not available separately.
(b) Estimated on basis of knowledge of industries in question.
(c) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1938.
(d) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1938.
(e) Estimated on basis of knowledge of industries in question.
(f) Estimated on basis of knowledge of industries in question.
(g) Estimated on basis of knowledge of industries in question.
(h) Estimated on basis of knowledge of industries in question.
(i) Estimated on basis of knowledge of industries in question.
(j) Estimated on basis of knowledge of industries in question.
(k) Estimated on basis of knowledge of industries in question.
(l) Estimated on basis of knowledge of industries in question.
(m) Estimated on basis of knowledge of industries in question.
(n) Estimated on basis of knowledge of industries in question.
(o) Estimated on basis of knowledge of industries in question.
(p) Estimated on basis of knowledge of industries in question.
(q) Estimated on basis of knowledge of industries in question.
(r) Estimated on basis of knowledge of industries in question.
(s) Estimated on basis of knowledge of industries in question.
(t) Estimated on basis of knowledge of industries in question.
(u) Estimated on basis of knowledge of industries in question.
(v) Estimated on basis of knowledge of industries in question.
(w) Estimated on basis of knowledge of industries in question.
(x) Estimated on basis of knowledge of industries in question.
(y) Estimated on basis of knowledge of industries in question.
(z) Estimated on basis of knowledge of industries in question.

[illegible]

(c) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1938.
(d) Figures are from Census of the United Kingdom, 1931.
(e) Figures are from Census of the United Kingdom, 1931.
(f) Figures are from Census of the United Kingdom, 1931.
(g) Figures are from Census of the United Kingdom, 1931.
(h) Figures are from Census of the United Kingdom, 1931.
(i) Figures are from Census of the United Kingdom, 1931.
(j) Figures are from Census of the United Kingdom, 1931.
(k) Figures are from Census of the United Kingdom, 1931.
(l) Figures are from Census of the United Kingdom, 1931.
(m) Figures are from Census of the United Kingdom, 1931.
(n) Figures are from Census of the United Kingdom, 1931.
(o) Figures are from Census of the United Kingdom, 1931.
(p) Figures are from Census of the United Kingdom, 1931.
(q) Figures are from Census of the United Kingdom, 1931.
(r) Figures are from Census of the United Kingdom, 1931.
(s) Figures are from Census of the United Kingdom, 1931.
(t) Figures are from Census of the United Kingdom, 1931.
(u) Figures are from Census of the United Kingdom, 1931.
(v) Figures are from Census of the United Kingdom, 1931.
(w) Figures are from Census of the United Kingdom, 1931.
(x) Figures are from Census of the United Kingdom, 1931.
(y) Figures are from Census of the United Kingdom, 1931.
(z) Figures are from Census of the United Kingdom, 1931.

(*) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1938.
(†) Estimated on basis of knowledge of industries in question.
(‡) Not available separately.
(§) Not available.
(||) Figures are from 1935 Census of Occupations.
(¶) Figures are from Census of Trade and Industry.

(1) Not available.
(2) Not available.
(3) Estimated on basis of knowledge of industries in question.
(4) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1938.
(5) Figures are from Census of Trade.
(6) Figures are from Census of Trade.

(*) Not available.
 (†) Estimated on basis of knowledge of industries in question.
 (‡) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1938.
 (§) Figures are from Census of Production.

(1) Not available.
 (2) Estimated on basis of knowledge of industries in question.
 (3) Figures are from Ministry of Labour and measure the growth of employment from 1928 to 1948.
 (4) Figures are from Census of India—
 (a) Figures are from Census of Decade—
 (b) Figures are from 1951 Census of Decade—

/ Column 9a. *Location Quotient.*

This gives the degree of concentration of a particular industry in a specific region (London in this case). It is obtained by dividing the percentage of the national total of the *particular* industry to be found in that region by the percentage of *all* industry in that region.

Column 13. *Coefficient of Localisation.*

This gives a general picture of the degree of local concentration of a *particular* industry as compared with the distribution of the *working population as a whole*. It is the sum (divided by 100) of the plus deviations of the regional percentages of all workers in the industry from the corresponding regional percentages of all workers in *all* industry. Complete local coincidence of the industry with all industry gives a coefficient of 0; complete differentiation gives a figure approaching 1.

Column 13a. *Coefficient of Linkage.*

This measures the location of a *particular* industry compared to that of another—agriculture in this case. It is the sum (divided by 100 and subtracted from unity) of the plus deviations of the regional percentages of all workers in the *particular* industry from the corresponding regional percentages of all workers in the other industry.

Column 10. *Size of Plants.*

1 — Small — 50 per cent. of persons employed in establishments with less than 50 employees, or 60 per cent. in less than 100.

2 — Smallish — 50 per cent. of persons employed in establishments with 25–100 or 50–200 employees, or 60 per cent. in establishments with 25–200.

3 — Medium — 50 per cent. of persons employed in establishments with 100–500 employees, or 60 per cent. in establishments with 50–500.

4 — Largish — 50 per cent. of persons employed in establishments with more than 500 employees.

5 — Large — 50 per cent. of persons employed in establishments with more than 1,000 employees.

None — No prevailing size; *i.e.* all sizes fairly represented.

(3) Bias toward smaller size. 60 per cent. of persons employed in establishments with less than 200.

(4) Bias toward larger size. 75 per cent. of persons employed in establishments with more than 200.

— (1) Not available; *i.e.* size grading indeterminate.

Agricultural Engineering, for instance, is not separately distinguished by the Ministry of Labour. In other cases the definitions of the industry differ widely according to source.* No industry is listed, however, for which at least two of the three sources of information were not available.

The numbers occupied are those given by the Census of Population 1931. No industry is listed which occupied less than 5000.

Table AA gives the list of industries provisionally selected. Where data are drawn from the Census of Production or the Ministry of Labour, the second and third columns give the titles used in those sources, corresponding to the titles used in the Census of Population. Correspondence in the classification of industries is, however, not always very exact, and is sometimes non-existent. In this case data are marked $\times$ for "not available."

Columns 4 and 5

The sex and age distribution were obtained from the Census of Population 1931. Column 4 giving the percentage that women form among the total occupied needs no explanation. The range of variation stretches from 3 per cent. in saw mills to 69 per cent. in tin-boxes. For *all* industries 30 per cent. of the total occupied were women. So, for assessing suitability for rural dispersion, 30 per cent. or more of women among the total occupied may be accepted as a favourable indication; 15-30 per cent. as neutral; below 15 per cent. as an unfavourable indication.†

Column 5 is more complicated in its assessment, since, unlike men and women, old and young are relative terms. As a shorthand description of the age structure the following symbols are used.

Four age groups are distinguished, the youngster from 14 to 17 inclusive, junior adults from 18 to 29 inclusive, senior adults from 30 to 59 inclusive and "venerables" 60 and over.

Among the total working population as a whole the proportion in each of these age groups is 10 per cent., 34.2 per cent., 47.5 per cent., and 8.3 per cent. successively, and no symbol is used if the proportions in any industry are respectively within the limits 6.8-13.2 per cent. for youngsters, 29.6-38.8 per cent. for juniors, 41.5-53.5 per cent. for seniors or 5.1-11.5 per cent. for venerables. If these proportions are above the limits, the symbols capital Y, J, S or V appear; if below the limits, the symbols small y, j, s, v.

In assessing suitability for rural dispersion an above-limit proportion of young persons (Y) and junior adults (J) may be taken as a favourable indication, a below-limit proportion of young persons (y) and junior adults (j) as an unfavourable indication. Other age-structures may be considered neutral.

Column 6

The statement of the seasonal fluctuation to which industries are liable is taken from Saunders' *Seasonal Variations in Employment*, which is, in turn, based on the Ministry of Labour's Employment Returns. For that reason specific information is not available for some industries.

In assessing suitability for rural dispersion a peak of activity in the summer is taken as an unfavourable indication, and peaks in spring or autumn as neutral.

* E.g., "Celluloid and Similar Compositions," Biscuits, Jam-making and Fruit Preserving. See Table AA.

† Table B summarizes these and the following assessments.

Column 7

The growth of the industry was measured wherever possible by the increase in the average number of persons employed between 1924 and 1935 shown in the Census of Production (Table 1A for each separate industry in the 1935 Census). An auxiliary measure of growth that was used for checking up, but not recorded in Table A unless the primary measure was not possible to secure, was the increase in the Ministry of Labour's returns of insured persons in employment between 1923 and 1938. The Census of Production has a classification of industry more suitable for our purpose; but, on the other hand, 1923 and 1938 are years that probably represent the general trend of industry, apart from trade cycles, more fairly than 1924 and 1935. In 1923 the percentage unemployed in Great Britain and Northern Ireland was 11·7 per cent., in 1924 10·3 per cent., in 1935 15·5 per cent. and in 1938 12·5 per cent.

In assessing suitability for rural dispersion account may be taken of the fact that according to the Ministry of Labour, the increase in employment between 1923 and 1938 was 14·9 per cent. for manufacturing industries and 21·5 per cent. for all industries. Between 1924 and 1935 the increase for all industries was only 13·3 per cent. Growth in employment of 15 per cent. or over may be accepted as a favourable indication for the industry, growth less than 15 per cent. as neutral, and a fall of over 1 per cent. in employment as unfavourable.

Column 8

The amplitude of the trade cycle is measured by the proportionate drop in employment in each particular industry from the average of 1929 and 1935 to 1932. This gives the deviation from trend. It would, of course, be more reliable to have used more than one trade cycle for the computation, but unfortunately the comprehensive employment returns only go back to 1923, and just miss the trade slump of 1920–22, previous to that of 1929–32.

In assessing suitability for rural dispersion, account may be taken of the fact that for the insured workers as a whole, the decline in employment between 1929/35 and 1932 was 9·0 per cent. A decline of 9·0 per cent. or more for any one industry may be taken as an unfavourable (negative) indication for dispersion, a decline from 4·0 per cent. to less than 9·0 per cent. as neutral, and a decline in employment less than 4·0 per cent. or a rise as a favourable (positive) indication.

Column 9

"Greater London" is the only Region distinguished by the Census of Population or by the Census of Production which is completely or almost completely built-up.* It is also, of course, the area that has been most criticized as congested, and from which industries are urged most strongly to disperse. The fact that an industry is localized in the London area as measured by a location quotient † over unity is a favourable indication for dispersion. A location quotient in London between 0·2 and 1·0 may be taken as neutral and a quotient below 0·2 as unfavourable to dispersion—there is little to disperse.

But parallel to the statistically computed tests of concentration in a congested area, an estimate must be made how far congestion is economically

* The region covered is roughly the area within a fifteen mile radius of Charing Cross. If the Population Census is used location quotients can be obtained for any other congested areas within a Region. This might reveal other industries suitable for dispersion.

† See Appendix.

explicable. If a particular industry has a location quotient in London over unity (*i.e.* if it occupies a number of workers out of proportion to London's proportion of the national working population) and there is little to explain it economically, then clearly the indication favourable to dispersion stays. But if there is a probable economic explanation, the positive indication in favour of dispersion in column 9a will be negated for at least part of the industry in column 9b.* The economic explanations put forward in Table A by means of symbols are that the industry is rooted to sources of supply (*S*) or demand (*D*), or linked (*L*) with some more or less fixed industry in a congested area to which it has to be near because of transport or communication costs or because of the need for contact between producers. These other linked industries may in turn be a source of supply (*LS*) or demand (*LD*). Thus part of printing is linked with a source of demand—newspaper publishing largely fixed in London; while cattle and poultry food-making is partially linked with a source of supply—sugar refining.† Proximity to sources of supply is also likely to be economically important in industries assembling parts supplied from a wide variety of industries all in one area. Examples are electrical apparatus, branches of engineering, carriages etc.

London and other ports do not supply raw materials from their soil, but import basic materials. Hence a frequent explanation of a high location quotient for an industry in a port is that it is rooted to imported supplies. Tanning uses supplies of imported hides and tanning agents.‡ Furniture is made of imported timber, sugar-refining refines imported cane-sugar. In all these cases there are alternative home supplies (*e.g.*, *beet* sugar), but the possibilities of dispersion depend largely on the relative development of these sources of supply.

Column 10

The prevailing size of plant does not mean the average (arithmetic mean) size of plant obtained by dividing the total numbers employed in an industry by the number of plants. This might give a very false picture, since the frequency distribution of size of plant is by no means symmetrical. The type of method adopted is described in my *Logic of Industrial Organization* § and is based on the distribution of workers over plants of various size ranges. A concentration of 50 per cent. or 60 per cent. of all workers within certain fairly narrow ranges of size constitutes that size as prevalent. Often, however, no prevalent size can be detected. The notes to the table give the precise "concentration" required to establish the prevalent size as 1 (small) 2, 3, 4 or 5 (large). The Scott committee on Land Utilization has declared in favour of dispersing smaller rather than larger plants into rural areas. Prevailing plant sizes 1 and 2 (*i.e.*, not above 200 employees) or no prevailing size are taken as a favourable indication for the dispersal of the industry; prevalence of size 3 or 4 as neutral; prevalence of size 5 (*i.e.*, over 1,000 employees) as definitely unfavourable.||

* The indications of column 9b are thus tabulated as either O or — but never +. Column 9b should logically be placed among the Practical Feasibility columns except for its close relation to column 9a.

† See Wilfred Smith, *The Distribution of Population and the Location of Industry on Merseyside* (pp. 79, 96), where similar rooting to imports occur as in London.

§ Chapter II.

|| Two further classes: (2) bias toward smaller, (4) bias toward larger plants, are distinguished—see note to Table A. In making assessments for dispersal, class (2) is included with 2, (4) with 4.

Column 11

Here the assessment is purely qualitative. Disadvantages to the country, such as effluents or small necessarily connected with an industry, form a negative indication for the dispersal of that industry, advantages in country location, such as an industry's need for purity of air form a positive indication.

Column 12-14

For these columns the tests for dispersion are of practical feasibility rather than desirability. Here the indications for or against dispersion depend, as already explained, on whether industries (a) are in their existing location "rooted" to fixed supplies or final markets, or "linked" to some other industry providing supplies or markets; (b) are already fully dispersed among the population as residentiary; (c) have a need for a common centre or cluster of plants in the same industry. It is mainly indications of this practical sort, where negative to dispersion, that have rejected or vetoed industries from inclusion in the table altogether.

Column 12a and b

How far industries are "rooted to the soil" or generally linked with agricultural production or country supplies and demands, can be partially tested by the coefficient of linkage with agriculture.* A high coefficient of linkage, say 0.45 and above, tends to indicate positive conditions favourable to dispersion in rural areas. Column 12b "checks" this statistical test by economic reasoning mainly in terms of relative transport costs of agricultural supplies to the factory or of factory products to agricultural markets.

A medium, say 0.35 to 0.44, coefficient of linkage with agriculture, is not necessarily an unfavourable indication for rural dispersion, and may be considered neutral, and though a lower coefficient is unfavourable, it should not veto the industry off the list altogether. Such a prohibitively unfavourable indication would occur if the industry were linked with another industry fixed in a congested urban area. Probable causes of such a linkage have already been assessed in column 9b in connection with location in London and, if required, coefficients of linkage could be computed between any suspected industries in the London area. If dispersion from other areas were contemplated, columns similar to 9a and 9b would assess statistical location quotients for those areas and give possible explanations in terms of linkage and rooting (e.g., in mining areas).

Columns 13a and 13b

The coefficient of localization is used as an index of the degree of local concentration of any particular industry. As will be noticed from the example of its calculation given in the Appendix, the coefficient measures the localization of the given industry *in relation to the distribution of the occupied or industrial population as a whole*. This appears to me the significant fact in the localization of a particular industry—not the geographical incidence of those engaged in the industry over expanses of land. The localization of industry *in general* may, of course, be measured by density of population *per land area*; it is roughly equivalent to urbanization. But this is not what economists usually seem to mean by localization. Professor Robertson † makes it a question of "the differentia-

* See Appendix for definition and examples.

† *Control of Industry*, Chapter III.

tion or division of labour between different countries or districts," and Marshall in a footnote * illustrates the conception by citing one Russian village that "makes nothing but spokes for the wheels of vehicles, another nothing but the bodies and so on." A village is a collection of people, and the emphasis appears to be on the *proportion of the total population* or of the total of labour found in particular industries. If the criteria of the localization of an industry inside England were to be mere geographical incidence, most industries found at all in the London region would have to be counted as localized there, since London covers relatively to the whole country such a small geographical area.

Two coefficients of localization are given, one based on the Regions distinguished by the Census of Population, the other on those distinguished by the Census of Production. In the case of the Census of Population it is possible to base the coefficients for particular industries on smaller divisions of the country, but at the present preliminary stage of the enquiry the lengthy calculations required are not worth while. To judge from such calculation made on sample industries the general ranking of industries by grade of localization would not be much affected. Considering the great differences in industrial and regional classification of the two sources of these tests—the Census of Production (13a) and the Census of Population (13b), the coefficients agree remarkably closely except for certain industries such as brooms and brushes, saw mills, boots and shoes, and saddlery. In these industries the higher coefficient of localization is based on the Census of Production, which does not record the numerous factories employing 10 or less workers. These very small factories are largely engaged in repair or jobbing, are scattered parallel to the population and not localized, and their omission thus tends to raise the coefficient of localization. In addition, the same concentrations of the brush trade fall into different regions according to the Census used.

A high coefficient of localization derived from either source is an indication of an economic advantage in clustering, the probability of which should (according to the precedent of columns 9b and 12b) be checked by economic reasoning. But since, all told, either in column 13a or 13b, there are only three coefficients over 0.47 and none over 0.57, this column is here, in practice, unnecessary.

A high coefficient of localization explicable on economic grounds is the main test for vetoing industries altogether from the table. The "external" economies of common marketing and service facilities, of a pool of skilled labour, of subsidiary industries and so on † that are connected with the clustering or localization of industry may make the dispersion of single factories away from the cluster an economic impossibility, unless that single factory has a very individual product or a reputation apart from factories in the same industry. Taking the British industries with the highest coefficients of localization one by one, most of them ‡ seem to produce the bulk of their output from factories of medium size. Possibly the external economies of a large cluster of smaller organizations take the place of the internal economies of a few larger organizations. Though small or medium factories may be more desirable for dispersion than large, their need for outside services nearby may make their dispersion less practical.

* *Principles of Economics*, Book IV, Chap. XI, para. 2, 6th Ed.

† Marshall, *Principles of Economics*, Book IV, Chap. XI.

‡ See Florence, *Architectural Review*, March 1943, "The Technique of Industrial Location," Table D.

TABLE B
Summary of Assessments

Column in Table A.	Women, per cent.	Age Struc- ture	Seasonal Peak	Growth	Cyclic Fall	London Location		Pre- valing Plant Size	Amen- ities	Link with Agriculture		Degree of Localization		Power per Man
						9a	9b			12a	12b	13a	13b	
Basis of Summary Assessment	40%+ 15%+	Y or J y or j	Winter Summer	13%+ Fall	4%— 9%+	1-0+	8b	1, 2, or none	11	0-13+	Signs	0-21 to 0-43 0-60+ or 0-10—	13b	11
1. Agricultural Engineering	—	—	+	—	X	—	—	X	—	+	+	+	+	+
2. Carriages, Carts and Vans	—	—	+	—	—	—	—	—	—	+	+	+	+	+
3. Constructional Engineering	—	—	+	—	—	—	—	—	—	+	+	+	+	+
4. Electrical Apparatus	—	—	+	—	—	—	—	—	—	+	+	+	+	+
4a. Accumulators and Batteries	+	X	X	X	X	+	—	+	—	X	+	+	+	+
4b. Other Electric Manufactures	+	X	X	X	X	+	—	+	—	X	+	+	+	+
5. Heating and Ventilating	—	+	+	+	—	+	—	—	—	+	+	+	+	+
6. Tin Boxes	—	+	+	+	—	+	—	—	—	+	+	+	+	+
7. Bacon, Hams and Sausages	—	+	+	+	—	+	—	—	—	+	+	+	+	+
8. Biscuits	—	+	+	+	—	+	—	—	—	+	+	+	+	+
9. Butter, Cheese, etc.	—	+	+	+	—	+	—	—	—	+	+	+	+	+
10. Cattle and Poultry Foods	—	+	+	+	—	+	—	—	—	+	+	+	+	+
11. Grain Milling	—	—	—	+	—	+	—	—	—	+	+	+	+	+
12. Jam-making, etc.	—	—	—	+	—	+	—	—	—	+	+	+	+	+
13. Minerals, etc.	—	—	—	+	—	+	—	—	—	+	+	+	+	+
14. Sugar Confectionery, etc.	—	—	—	+	—	+	—	—	—	+	+	+	+	+
15. Sugar-making and Refining	—	—	—	+	—	+	—	—	—	+	+	+	+	+
16. Boots, Shoes, etc.	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17. Bricks and Tiles, etc.	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18. Brooms and Brushes	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19. Furniture-making, etc.	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20. Canvas Goods	—	—	—	—	—	—	—	—	—	—	—	—	—	—
21. Celluloid and Plastics	—	—	—	—	—	—	—	—	—	—	—	—	—	—
22. Felting, Tanning, etc.	—	—	—	—	—	—	—	—	—	—	—	—	—	—
23. Feather, Toys, etc.	—	—	—	—	—	—	—	—	—	—	—	—	—	—
24. Paper and Board-making	—	—	—	—	—	—	—	—	—	—	—	—	—	—
25. Printing, Book-binding, etc.	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26. Rope, Cord, Twine	—	—	—	—	—	—	—	—	—	—	—	—	—	—
27. Saddlery and Leather Goods	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28. Saw Mills and Joinery Work	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29. Toys, Sports Requisites	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30. Paints and Varnish, etc.	—	—	—	—	—	—	—	—	—	—	—	—	—	—

o Neutral.

x Not available.

— Negative.

— Positive.

At the other end of the scale of coefficients of localization, a coefficient below 0.21 probably, and below 0.10 certainly, indicates a residentiary industry which must be distributed parallel with the population. Such an industry is already dispersed and cannot be dispersed further.

Thus a coefficient of localization between 0.21 and 0.46 may be taken as a favourable indication of a dispersibility wider than already exists, a coefficient between 0.10 and 0.20 or between 0.46 and 0.60 as neutral, and coefficients below 0.10 and over 0.60 as a negative indication of further dispersibility.

Column 14

Horse-power in use per worker is the nearest approach to a simple index available for all industries of the degree to which an industry is rooted to materials owing to its being "heavy." On the whole heavy materials require higher power per worker for their conversion.* A horse-power per worker of 1.0 or less may be taken as a favourable indication for dispersal, a horse-power per worker of 1.0-3.0 as neutral, over 3.0 as unfavourable, *if the materials are not found in rural areas*. But if, as indicated in column 12b, there is a linkage with agriculture explained by the presence of supplies, then clearly the fact that these materials are heavy makes rural location *more* feasible. Thus, a horse-power per man over 1.0 will be taken as favourable if the symbol "S" appears in column 12b.

§ 3. Summary of assessments

The assessments of the thirty-two selected industries in each of the fourteen columns 4 to 14 can now be summarized in Table B. A plus sign is given where the assessment is favourable to dispersion, a nought where it is neutral, and a minus sign where it is unfavourable. The selective and "rejective" values of the plus and minus signs in the various columns are, of course, not necessarily equal. A minus sign against practical feasibility in any of the last five columns must carry particular weight.† In fact, however, there are only five such cases in Table B. Mineral Waters may be already (according to one coefficient of localization) so dispersed that further dispersion is difficult. Paper and Board making, Paints and Varnishes, Fertilizers and Dips, and Cattle and Poultry Food have a high horse-power per worker, indicating a heavy industry, without drawing their heavy supplies from the country. But two of these make for the agricultural market.

Once an industry's practical feasibility for dispersion is admitted, however, a rough estimate of its general suitability can be obtained by subtracting the number of minus and nought signs from the number of plus signs. Though there is in each of the columns a similar or a rather greater probability for any industry to show either a nought or a minus rather than a plus sign,‡ twenty-five out of

* Some investigators (e.g., Wilfred Smith in his study of Merseyside industries (see footnote, p. 7)) have used as a test of a heavy industry a high proportion of material costs to total value. But this gives the economic value of the material rather than its physical properties. Thus the clay used for brick-making, heavy enough to "root" the industry, constitutes a very low proportion of gross value. On the other hand, jewellery industry materials show a high proportion, though the jewellery industry is neither heavy nor rooted.

† Column 9b, though assessing a practical feasibility, only ties down the London part of the industry by a negative.

‡ The dividing line between a favourable positive assessment and a neutral or negative one was the average figure for all industry or for all manufacturing in columns 4, 7 and 9a; it was less than average (the average divided neutral from negative assess-

the thirty-two industries tabled show in fact as many plus signs as noughts and negatives put together, and only one, the shoe industry, shows an excess of noughts and negatives over plusses of more than two. In the case of all the seven industries where plusses are in a minority, it is the frequency of nought signs indicating neutrality, rather than positively unfavourable negative signs that tips the balance. There is no industry in the list where negative indications are more than positive.

The selection of industries has proceeded so far by means of statistical and certain economic tests. There are grave limitations to both of these. The economic tests for the symbols in columns 9b and 12b are not based on exact measurement. The statistical tests—though they are exact measures—are based on data collected by the Census, or on other official returns, and these are often not sufficiently detailed for the purpose. Many of the “industries” that are distinguished are really loose groups of several distinctive industries. For instance, Electrical Apparatus, for which a full series of tests are available, embraces the following specific industries or subindustries.

Accumulator and Battery Industry; Cables; Lamps and Valves;
Electric Lighting Accessories; and
Electric Heating Apparatus (for which incomplete information is given in Table A in lines 4a and 4b); together with the—
Telephone and Telegraph Apparatus; Wireless Apparatus; and other distinctive industries (for which no separate information is available).

Each of these specific industries or sub-industries may have quite a different pattern of location, size of plant, trade cycle and so on. The main omissions in

ment) in column 8; and in columns 5 and 6 positive assessments are as likely as negative only—not including the neutral. Column 12b admits no minus sign, but column 9b no plus sign. The remaining columns showing figures are 10, 12a, and 13a and b. Here the frequency distribution of figures for *all* available industries are as follows:—

Column 10. Prevailing size of Plants. Distribution of all industries, according to indicative sign.

+ Size 1 and 2 or None Prevailing	...	53
○ Size 3 and 4	... ..	42
— Size 5	... ..	15

Column 12. Coefficient of Linkage with Agriculture. Distribution of all industries with available data according to indicative sign.

+ 0.45 or over	... ..	53	40%
○ 0.44 or less	... ..	79	60%

Column 13b. Coefficients of Localization. Distribution of all Industries with available data according to indicative sign (13a would show similar distribution).

+ 0.21 to 0.45	... ..	69	50%
○ { 0.11 to 0.20	... ..	13	27%
{ 0.46 to 0.59	... ..	24	
— { 0.00 to 0.10	... ..	2	23%
{ 0.60 plus	... ..	29	

Column 14. H.P. per worker. Distribution of all industries with available data according to indicative sign.

+ 0.0 to 1.0	... ..	28
○ 1.0 to 3.0	... ..	30
— 3.0 plus	... ..	24

To the industries showing + must be added the ○ or — industries that are linked to agriculture, not a large number in all.

my provisional list of industries suitable for rural dispersion is, in fact, due to the wide coverage adopted by all the official classifications of the lighter metal and engineering industries and light assembly industries generally. Too many of such industries suitable for rural dispersion are lumped together with unsuitable industries under one official title making statistical analysis in Table A impossible.

In any case, these statistics refer to the immediate past, not the future, and in planning we are looking to the future. It is, therefore, necessary to supplement economic reasoning and statistical measurement with the knowledge possessed by experts of technical developments on which the future of industrial organization is likely to be based. In my paper to the 1942 Conference of the Town and Country Planning Association * I gave three factors that might set a precedent new in rural location :—

(i) New developments in the cultivation of the land. More forestry might tempt woodworking and furniture factories and possibly paper-making, into the forestry areas; growing of more fruit and vegetables might induce more processing and canning factories into the horticultural areas.

(ii) Cheaper rural electrical power. Where industries require considerable power per man or per given output (e.g., saw-milling, grain-milling, glass-making, paper-making, sugar refinery) power costs may at present be preventing dispersion.

(iii) Self-contained factories or factory estates with their own auxiliary and servicing departments, or factories owned by a large firm prepared to service from headquarters will not need other factories and an industrialized neighbourhood for securing external economies; the same economies will be obtained internally.

§ 4. *Further application of research technique*

This research technique making use of economic reasoning, statistical measurements and expert knowledge is not confined to solving the problem of industrial dispersion into rural areas. It may be applied equally fruitfully to the selection of industries for depressed areas suffering from unemployment, or to the selection of industries for purposes of diversifying an area over-specializing in one or a few unstable industries.

Where the purpose is to prevent unemployment in the future, particular attention must be directed to selecting growing industries not liable to cyclical fluctuation. Where the purpose is diversification, attention must be particularly directed to the balancing of the existing structure in the employment of the sexes and of age-groups, in "dovetailing" seasonal fluctuations and "splicing" decaying with growing industries.

It may be said, in conclusion, that in any area—whether it is a problem area or not—a survey of the existing industrial and occupational structure of that area is an essential for the efficient selection and control of its industries.

Elsewhere † I have indicated methods of measuring some of the existing economic characteristics of an area such as the degree of its specialization in certain industries. Different areas have different needs and indices can be worked out both to assess those needs and to measure requirements to fit those needs. There are possible indices, for instance, to show how far an area is

* *Industry and Rural Life*, pp. 45–46.

† *Architectural Review*, March 1943, pp. 59–64.

deficient in service and recreational industries, in industries employing women or any specific age-group, in industries that are seasonally or cyclically stable, or are growing. If there is seasonal or cyclical fluctuation in local employment, the incidence can be accurately measured to show the need for selecting industries of opposite fluctuation. To develop this technique would require another paper. But I must not end this present paper without pointing out that for a successful fitting of industry to an area the characteristics of the area are no less important to measure than the characteristics of the industry.

APPENDIX

Calculation of measures of the location of particular industries

The measures are all based on the division region by region of the total of workers for all industry * (Table C, col. b) or for various particular industries (Table C, cols. c and f). The number of workers in each region is expressed as a "regional percentage" of the national total.

TABLE C

Example of Calculation of Quotients and Coefficients

Area or Region of Britain (a)	Total Occupied Population, percentage of all workers (b)	Motor and Cycle Accessories			Non-Ferrous Tube and Pipe	
		Percentage of all workers (c)	Location Quotient (c - b) (d)	Plus Deviation from (b); (c - b) (e)	Percentage of all workers (f)	Plus Deviations from (c) (g)
ALL AREAS ...	100.0	100.0	—	—	100.0	—
London ...	19.6	20.1	1.0	+ 0.5	6.3	—
S.E. ...	11.3	2.2	0.2	—	0.7	—
North I ...	4.4	0.2	0.0	—	1.1	+ 0.9
North II ...	2.7	0.2	0.1	—	0.1	—
North III ...	7.9	0.8	0.1	—	7.9	+ 7.1
North IV ...	14.8	1.4	0.1	—	6.0	+ 4.6
Midlands I ...	10.3	72.2	7.0	+ 61.9	73.0	+ 0.8
Midlands II ...	5.4	1.1	0.2	—	0.5	—
East ...	3.8	0.6	0.2	—	0.0	—
South-West ...	4.3	0.2	0.1	—	0.3	+ 0.1
Wales I ...	3.7	0.1	0.0	—	0.1	—
Wales II ...	1.4	0.1	0.1	—	2.1	+ 2.0
Scotland I ...	0.5	0.0	0.0	—	0.0	—
Scotland II ...	2.9	0.2	0.1	—	0.1	—
Scotland III ...	5.0	0.4	0.1	—	1.7	+ 1.3
Scotland IV ...	2.0	0.1	0.0	—	0.1	—
Total of Deviations...				+ 62.4		+ 16.8
Coefficient of Localization ...				0.624		
Coefficient of Linkage of Accessories and Tube, etc. ..						1 — 0.168 = 0.832

1. *The location quotients* (Table C, col. d) give the degree of concentration of a particular industry in particular regions. When workers in all industry and

* *E.g.*, all occupied persons in the Census of Population; all employed persons in the total of undertakings covered by the Census of Production.

workers in various industries are divided up region by region, it is obtained by dividing the percentage of workers in the particular industry in that region by the percentage of workers in all industry in that region. A quotient of 1 indicates that the percentages of workers in the particular and in all industry coincide in the region.

2. *The coefficient of localization* (Table C, col. e) gives a general picture of the degree of local concentration of a particular industry as compared with the distribution of the working population as a whole. When workers are divided up region by region as percentages of their total, it is the sum (divided by 100) of the plus deviations of the regional percentages of workers in the particular industry from the corresponding regional percentages of workers in all industry. Complete coincidence region by region of the particular industry with all industry gives a coefficient of 0; extreme differentiation gives a figure approaching 1.

3. *The coefficient of linkage* (Table C, col. g) measures the location of a particular industry compared to that of another. When workers in various industries are divided up region by region as percentages of their total, it is the sum (divided by 100 and subtracted from unity) of the plus deviations of the regional percentages of workers in the particular industry from the corresponding regional percentages of workers in the other industry. Complete coincidence region by region of the two industries gives a coefficient of linkage of 1; extreme differentiation 0.

DISCUSSION ON PROFESSOR FLORENCE'S PAPER

MR. R. G. GLENDAY: It gives me great pleasure to propose a vote of thanks to Professor Sargent Florence for his most interesting and timely paper. Although the war is not yet won, and, indeed, so far as its Western arena is concerned, the major land battle has still to be joined, the problem of post-war industrial dispersion has already begun to occupy attention in official quarters. I refer in particular to the preparations being made for the demobilization of surplus capacity as it accrues and the measures for securing a more equable distribution of industries in the different regions after the war by creating "development areas" to prevent the re-emergence of what in pre-war days used to be known as the "depressed areas." It is, I take it, the next stage beyond this preliminary work with which Professor Florence is primarily concerned. Let me say at once that while I entirely sympathize with his line of approach, and feel he is to be congratulated on breaking new ground, I am not entirely happy about it. May I briefly refer to one or two grounds for uneasiness?

First, Professor Sargent Florence seems to take as the basis for his approach what I may term a static view of the problem, what the cinema photographer would call a "still." But industrial evolution is a moving picture. The instantaneous photograph which we take of industrial location to-day is a cross-section of a process which has a past, a present and a future. For example, when a new industry first emerges from the chrysalis stage it is common to find units widely distributed over the country. Time, competition and a variety of circumstances which have never been fully analysed lead to a gradual elimination of units, often in the end leaving the industry concentrated in a few areas with only a relatively small number of units reaching an important magnitude. I shall have something more to say about the future long-term trend of industry in a moment.

My second ground for uneasiness, which in a way is associated with the first, relates to Professor Sargent Florence's use of the word "rural" areas. I may illustrate my difficulty here by recalling an off-the-record reply I once made to a committee studying the industrialization of rural areas which enquired,

"What does British Industry regard as suitable industries for locating in rural areas?" My reply was to express disappointment at being asked this question, when British industrialists had been doing little else but locate industries in rural areas for the past two hundred years! I mention this in order to draw attention to what may easily become a source of confusion. It is one thing to suggest, as Professor Florence does under his first principle, that the object should be to select industries that might be used to offset *rural* unemployment by providing work for the surplus women that arise in agricultural areas; it is quite another to demand, as he does, under his second principle, that rural areas should be used to relieve *urban* congestion. In the latter case the people *and* factories (with new housing also) would have to be settled in what till then were purely rural areas, with the result that these rural areas would be likely progressively to become urban areas—assuming industrial evolution to continue—so that the problem of selecting occupations specially suited to a rural environment would soon cease to be of importance, as the area would tend to become an urban one.

This brings me back to my first point, namely, the importance of seeing industrial evolution as a *continuing* historical process, spread out over time. If the future dispersion of industry is viewed against the background of its past evolution and dispersion, it surely becomes evident that in attempting to separate the problem into two largely independent parts, the urban and the rural, we are doing something artificial. Our present industrial system did not emerge out of the rural system that preceded, as something separate and independent of it, but as part of a *single* process of complementary development. It was in the main largely only because the Industrial Revolution in the eighteenth century was accompanied by an agricultural revolution—which enabled more food to be produced with less labour—that it was able to obtain the labour and food supplies needed for industrial employment; and this evolution has been a continuing one. Professor Sargant Florence, if I understand him aright, would now like to reverse this long-term trend. Or perhaps he would deny this, and say that his only desire is to speed up what is really only part of it. But before we can accept this we must take account of certain notable recent changes in the long-term trend of industrial evolution itself. I would suggest that over the past two decades there have been signs that we have been witnessing what may prove to be the culmination of that flood of economic and social change which got under way in the "industrial revolution" in the early part of the eighteenth century. That revolution, let me remind you, was quite an exceptional period in our history, though, as a recent historian has put it, "it has taken now two world wars to make us realize how exceptional it was." It was this industrial revolution more than anything which accounted for the vast increase in the population of England and Wales during the lifetime of George III from some 7,500,000 to 12,000,000, since when it has more than trebled. It was the inventions and discoveries that were the offspring of that revolution which helped to raise that population to over 40,000,000 by the opening of the present war. That wave of population growth has now definitely come to an end. In the future we shall not only have a rapidly ageing population, but one which is likely to decline in numbers. An estimate just published by the League of Nations experts suggests that a decline of some 4,000,000 in the population of England and Wales over the next twenty-five years is quite a possibility. The decline would be even greater than this but for the fact that the diminution of some 8,000,000 in the under 'forties will be partially offset by an increase of 4,000,000 among those in the older age groups. And this ageing is not an encouraging feature, either from a mobility or a planning point of view. Meantime, new inventions and discoveries will continue to increase both the speed and quantity of output per head—and per factory—that is, reduce the number of people and factories required to produce the country's industrial needs. Even before the present war *industry* proper was ceasing to be able to provide sufficient fresh expanding avenues of employment to absorb those displaced from existing industrial employments plus the new additions to the working population. Here and in other industrial-

ized countries "services" were providing the really expanding avenues of employment. Surely, in the years to come the probability is that, bearing in mind the vast war industrial expansion and dispersion that have occurred, we should expect that there would be need for fewer rather than for more new factories (apart from replacements), and that the size of our existing towns would on the average tend to contract rather than to expand. Looking still further ahead, we might find ourselves with too many rather than too few factories and industrial towns, and faced with the problem of avoiding the creation of derelict areas rather than that of establishing additional urban areas. But no one mentions these admitted tendencies—in particular, the trend of employment towards "services" and away from industry.

I raise these questions, not because I know the answers, but simply because they raise issues that must be faced. I am bound to say that when I contemplate the list of industries given by Professor Sargent Florence in his paper, in the light of current industrial conditions as I know them, I envisage the possibility of a serious over-expansion and duplication of capacity if an attempt were made to give effect to his policy, except to an extremely limited extent, and for a very limited period of time.

SIR GWILYM GIBBON, in seconding the vote of thanks, said: There is much loose talk about the location of industries, very many opinions and few facts, and this paper is to be welcomed on this account alone, as some corrective. It is instructive to remember that one reason for appointing the Barlow Commission was that there prevailed an impression that there was a drift of industries from the depressed areas to London. As a matter of fact, there was no drift at all, and that could easily have been ascertained. There is another reason for welcoming the paper. Planners as a body do not really know very much, compared with what needs to be known, about the location of industries. In this country planning began as an adjunct of housing and has suffered from some disabilities ever since. When I first had charge of the town planning department at the Ministry of Health I urged upon planners that planning should start with the means by which the people lived. The planners were not primarily to blame because more was not known; the ascertaining of the necessary facts and of the principles of sound location based upon them was more appropriately the job of economists and others whose training better qualified them for the task.

My trouble about the present paper is something like that of the proposer. It throws interesting sidelights on some aspects of the subject, but I am not sure how far it really helps in the actual work of planning or how far it reaches conclusions of real use. It seems to me that anything based on such broad categories as the author has taken, categories which include such diverse concerns, can at best lead only to very broad general conclusions.

Let me illustrate from the first of the industries he includes in Table AA as suitable for rural dispersion, namely, agricultural engineering. If the engineering requires a big workshop or factory, the probability is in favour of urban location, especially in the future, when machinery is going to be still more used in agriculture and more cheaply produced by methods which approximate at any rate to mass-production. On the other hand, if you have an undertaking which is mainly a service concern for refitting and repair, obviously a rural location has advantages, possibly combined with a centre for the hiring of machines for the smaller farmers, a public or co-operative or private centre. Other instances could be given. The obscurities which arise in the paper are not due to the author's failings, but to the failings of the data on which he has to base his conclusions.

I am in doubt also whether it is wise to deal with rural location in isolation. To illustrate; the author gives us among the advantages or disadvantages of country location the presence or absence of noxious fumes, smoke, effluents, and things of that character. But keen as I am on rural preservation—and I am a member of the executive of the C.P.R.E.—far be it from me to say that what

applies here to the country should not also apply to the town. After all, men, women and children are even more precious than fields or meadows. The right course is to prevent the nuisance, and more can be done to this end, if special efforts be made.

The author also says that absence of much cyclical fluctuation in employment is another factor in favour of rural location. But that, too, is not one whit less necessary in towns. One of the big problems of planning is to secure in a goodly number of our urban aggregations a better balance of industries so as to reduce the shocks of cyclical variation when they arise (for they will arise again, although, one hopes, not so seriously as in the past). I could give other illustrations of the desirability of dealing with the two together, town and country. We talk too much about rural location in general and are apt to overlook that the question takes a different colour according to whether it is proposed to set up a works in a village, in a country town, or—what is by no means the same—a town in the country, which may even be a town selected as suitable for some of the overspill of works and population from a large town.

Although much has been said by agricultural enthusiasts which I am almost tempted to describe as foolish, as though every yard of agricultural land was sacred and must not be touched for any other use, I see no reason why a general push should be given to the dispersal of industries into strictly agricultural areas. After all, unless there is good cause for doing otherwise, the right course in the national interest is to use good agricultural land for agricultural purposes—and also to avoid, again in the national interest, spoiling the unique treasure of our rural beauty and pleasantness. There is no need, I think, to press overmuch for dispersal into purely rural areas. I am not against introducing industries into the rural parts of the country. On the contrary, I have said in a recent publication that the one hope of reviving village life in many a place and, still more, of providing those services of water supply, sewage disposal, and gas and electricity, which are far too easily assumed by the Scott Committee, is to attract more population so as to obtain larger units. But the introduction of industries must as far as possible be suited to the local circumstances.

I, too, hope that nothing that I have said will deter Professor Florence from pursuing and extending his investigations, because we do really need to know far more about the location of industry. I have urged this for many years, and the need has become much more urgent. I hope therefore that Professor Florence will pursue his investigations further but will come much nearer to the actual problem, not the problem as it seems from the publications of Government departments, however excellent these may be in themselves, for that is not the road to the light.

The vote of thanks was now put to the meeting and carried unanimously.

MR. M. G. KENDALL said that from a statistical point of view this investigation stood or fell by the reliability of Professor Florence's coefficients, and this brought up a point of great theoretical interest which had not perhaps been adequately stressed in economic and statistical writings in the past. It arose from the distinction between a unit which was, so to speak, self-determined and a unit which was modifiable. In the ordinary textbook one introduced correlation by reference to such things as hair colour and eye colour in human beings, the unit being a human being, which could not be halved or divided, and equally in which there was no purpose in grouping. But there was a second class of unit in which the extent of the unit was very much a matter of choice. The effect could arise both in time and in space. To take a standard example, if one was correlating the marriage rate with trade, one could do it, assuming the information available, on the average of daily, weekly, monthly, annual, quinquennial, or decennial readings, and there was very little in trade or the marriage rate as such which indicated any one of these periods as preferable to any other. The important point was that a different value might be obtained for the correlation according to which unit was taken. What was the "real" correlation between trade and marriage rate?

The same thing applied to a geographical distribution. Professor Florence had necessarily had to work with regions; had the information been available he might equally well have worked with counties or made his sub-division even finer and worked with urban and rural districts. On the other hand, he might have gone in the opposite direction, taking larger areas. From a statistical point of view he could have done any of these things, and there was no reason why he should choose any one rather than any other. But, had he done so, he might have found some quite different results. In his Table C he gave sufficient material to test out this kind of thing. There were here 16 different groups, and Professor Florence gave for his coefficient of localization a value of 0.624. If he took those 16 regions in pairs and got 8, he would have a coefficient of 0.576; if he grouped them in sets of 4, he would get 0.371; if into single pairs, 0.218, and if he put them together he would get a coefficient of 0. On the other hand, if it were possible to go in the reverse direction, and divide 16 into 32 or 64, that value of 0.624 would go up and ultimately reach unity. By choosing one's modifiable geographical areas, one could get any value of the coefficient one pleased. It did not follow immediately that the coefficients had no value at all, but it did mean that one had to look at them extremely carefully.

From Professor Florence's point of view there were probably two favourable arguments. In the first place, he had not used these coefficients to measure anything in any absolute sense, but only to classify his industries into the three categories, unsuitable, suitable, or neutral. It might perhaps be said that even if the values of the coefficient altered, the rankings which they gave to the industries would remain. What would happen in those particular cases he did not know, but one could construct examples without much difficulty to show that by multiplying or sub-dividing units one not only altered the balance given, but might alter the order in which the industries were ranked. It was quite possible that an industry which was shown as unfavourable in one grouping might be shown as favourable in another.

Thus it seemed quite possible that the ultimate grouping which Professor Florence had arrived at might be completely misleading. There was one possible test. If one took London alone he presumed that information would be available for separate boroughs, or even smaller sub-divisions, and he would suggest to Professor Florence that he should carry out a test on that basis.

The other argument in the paper was that these regions were more or less pre-determined for the purpose of post-war planning. There would have to be some sort of regionalization, and Mr. Kendall had no doubt it would follow more or less on these lines. In fact, there were obvious advantages in selecting the regions fairly large and deliberately making them heterogeneous, so that the problems could be settled within the region without involving any of the usual squabbles which took place when there was joint jurisdiction. But, even so, he thought the theoretical point remained that in carrying out the analysis in Table B what Professor Florence had measured to some extent was not any abstract qualities of industry, but the qualities imposed on it by the nature of the regionalization, and it was quite possible that with a different regionalization totally different results would be obtained.

The difficulty about that conclusion was this, that if planning was to be carried out from the national standpoint—and one assumed that regional planning would be done in the national interest—it should not make any difference to the immediate action however these regions were grouped. Certain things would have to be done, certain industries would be put here and certain others put there in the national interest, and the ultimate course of action should be independent of the particular grid of measurement imposed by the statistical investigation.

It had occurred to him that there was one field of research from which Professor Florence might derive some assistance. This attenuation effect in coefficients had been remarked by the psychologist, who had a similar problem in the measurement of a rather nebulous thing called intelligence. One could not assess it directly. The subjects were given a battery of tests, and from the

numerical results one tried to evolve a measurement of intelligence. It was quite possible that something suggestive might be derived from that technique; but at the moment he saw very serious difficulty in accepting the results in Table B.

There were two other points he desired to mention. Professor Florence referred to the fact that agriculture employed a disproportionate number of men and of older workers. That was quite true, but one of the difficulties about agriculture was that there had not been a satisfactory influx of young men. If the pre-war position were taken as a measure of what ought to exist in agriculture, they might find themselves in conflict with agricultural policy.

The second point was rather of the same nature. The author said that agriculture did not on the whole constitute problem areas. He was there using employment as a measurement of problem areas, but the agricultural problem was not so much one of unemployment. The agricultural labourer out of work could nearly always get employment somewhere else. The agricultural problem was rather one of unemployed fields or unemployed farms, and from that point of view the criteria of suitability as measured by unemployment were not good ones for agriculture. Anyone who had worked with these difficult problems knew that Professor Florence deserved sympathy rather than criticism, but, all the same, there was the difficulty, and, unlike the previous two speakers, he hoped that his remarks would not be construed as uncritical!

MR. P. MOSS said that if it was in the national interest that industries should be located in rural areas, the question should be approached realistically and not, as had so often happened with rural problems, on an emotional or sentimental basis. He desired first to make a point on age distribution in agriculture. It was quite impossible to conceive of an old agricultural labourer unless one started with a young one. If it was assumed that there were in rural districts farms and factories, and that the age distribution in agriculture was going to remain heavily weighted in the direction of age, then one must assume that the young man had gone into the factory first, had worked there until he was 40 or 50, and had then decided to be an agricultural labourer. That theory would not work. He thought the author would be wise to ignore that particular factor in selecting industries for dispersal to rural areas.

A second point was whether the title of the paper could not have been more accurately expressed. It was, in fact, a question of the dispersal of industry to the smaller towns and larger villages rather than to rural areas as such. Further, a minor point which might have some significance was this, that the areas in which seasonal labour was most marked in agriculture tended to be those areas of most intense cultivation. If factories were brought into such areas and those factories also attracted other workers to come and live near them, thereby relieving the urban congestion, one was liable to find oneself doing something to the land that in the first place was never intended. In the first place, so far as he could see, the workers in one factory employing 200 persons might require 20 acres of housing. It might happen that quite accidentally an undue proportion of land suitable for intense cultivation would be transferred from that use to factory or consequential use in the way of housing. He did not wish to suggest that land of that kind was inviolate, but it was necessary to foresee what might happen. The question of linkage was most important. There was always a danger that the mere existence of a factory might provide an argument for the bringing in of another factory. That danger should be foreseen.

On reading the paper it struck him that great care had been taken to work out the coefficients to the third place of decimals, but no attempt had been made to give any of the factors any sort of weight. They were given simply the plus, the minus, or the nought. If the factors could be worked out to such a degree of accuracy it ought to be possible similarly to give appropriate weight to each of them.

DR. R. H. S. PHILLIPS said that although he wished to be fundamentally

critical of aspects of the paper, he recognized how much it contributed to the subject and what a big gap it filled in the statistical approach to town planning.

One of the most provocative aspects of the paper lay in the lack of a satisfactory definition of dispersal. If "dispersal" is *not* to mean (p. 99) "moving away" from concentrated areas, but only "directing future growth away" from them, how did the quality (II. 1 above)—*viz.*, "Industries disproportionately in a congested area, *e.g.*, London"—become a desirable quality for dispersal? Moreover, Professor Florence's very important reference to the effect of *external economies* in making uneconomic or impossible dispersal from developed large towns and clots of industry (see columns 13*a* and 13*b* of this paper), nullified II, 1 as a desirable quality, since London industries were precisely those with most external economies. Table B was relatively useless without a considered *weighting* of the columns, especially of columns 13*a* and *b*.

It seemed a mistake to narrow the issue by reference to specific economies (or desirables) such as the need for food industry in "pure" country areas, when in fact clear air was more or less irrelevant in most food-producing processes. In most cases proximity to the market or port was more vital and, as the Scott Report pointed out, such industries as jam making were already large and growing (Sec. 196). It seems to be a common error to state that the Scott Report favoured "industrial dispersion to rural areas." In fact, it pointed out the *dangers* of this to both industry and the country, and only Professor Dennison, in his Minority Report, advocated such dispersal. The present paper helped to make judgment on this point more objective. One must, however, look at the matter more broadly.

If we assumed that it was only "suitable" to move industries into rural areas if (i) the standard of living of the workers therein was not jeopardized or reduced and (ii) there was a net national benefit, certain statistical approaches seemed to be useful in discovering which industries, if any, are suited to rural dispersal. The four main categories of such statistics (all inadequately developed and in any case suitable more for theoretical analysis than for factual discovery) were as follows:—

First, information as to the buying powers of equal money wages in large towns as compared with rural or small town areas. It was already clear from analyses made in America and Germany, and from some made at home,* and from general knowledge, that many services simply could not be provided in the small communities. Most goods of a manufactured type tended to be scarce, and most municipal amenities were bound to be inadequately developed. This greatly affected the standard of living of incomers, who would find that houses in rural areas, of *equal quality and amenity* with those in the towns, are definitely more expensive. Power, water and education, where they existed as services, would also be more expensive, *quality for quality*.

Secondly, statistical information concerning the dis-economies to non-dispersed firms resulting from the dispersal of other industries from the original location concentration. These diseconomies will include administrative inconveniences due to the likelihood of control of dispersed firms having been previously centralized, to the ending of personal contact between administrators and other firms at regular intervals, and also to lack of contact with the mass of the buyers, etc. . . . There would probably also be figures relating to the loss of ability of employees to change their jobs. Removal from an area full of *external economies*, such as cheap telephones, haulage contractors, evening newspapers, technical institutes, and specialist firms (for example, of electricians and maintenance engineers), would not only be seriously detrimental to the case for dispersal owing to the expenses in a rural location, but might also help to weaken the usefulness of the external economies at the old location by depriving them of some support.

Thirdly, statistics bearing on the effect of rural settlement on agricultural (and especially pastoral milk) production were vital. Allied to them were

* See Ogburn, Wells, and others.

statistics of the agricultural quality of the land most likely to be cheap enough, nodal enough and flat enough for economic development. Such statistics were abundant and proved the tendency for the *best* agricultural land to fall before advancing development.

Finally, it should not be impossible to collect statistics relating to the cultural cost to the nation of building up communities which were necessarily strictly limited in size and therefore in outlook. Such statistics could be collected from improved psychological and intelligence test techniques and could include measurements of political democratic awareness (*e.g.*, votes), of reading habits and of the ability of small rural locations to support facilities for culture. Sociological statistics relating to the migration of women to large towns would not be irrelevant in this context.

Dr. Phillips drew no conclusions as to which industries, if any, such careful analyses would find to be suitable for location in rural areas. He simply suggested an obvious line of thought for those who believed in viewing this very practical subject through macroscopic rather than microscopic lenses. If such industries did exist, his third point would be important as tending to assist in the choice of locations which would cause least detriment to local development and national agriculture—probably the larger market towns. Much of what he suggested would, however, go against dispersal, which *should not be accepted as an inevitable policy*.

Professor Florence, however, seemed to be conscious of some of these points, judging from his closing phrase—"I must not end this paper without pointing out that for a successful fitting of industry to an area, the characteristics of the area are no less important to measure than the characteristics of the industry."

MR. C. R. FAX congratulated the author on having raised a fundamentally important topic. He himself had just completed a survey of two cross-sections of England on an agricultural mission, and it was staggering what changes had taken place in the location of industry. Many of them, of course, must be "off the record," but the question arose, how was the monster to be got back into the cage? Large farm areas, for example, had been taken up for aerodromes. There seemed to be no better solution than this detailed statistical method, that of taking the area and studying it in terms of those little things which together made up so often the problem of location. The author himself was in a marvellous area for doing that. North of Wolverhampton, in Staffordshire and Shropshire, there was a strange mixture of agriculture and industry. Some way of agreement must be found between agriculture and industry. Agriculture was now having the time of its life. Must it crash once again? One hoped it would not, but it would have to make concessions and adjustments, and he could not think of any better way than by this close regional investigation. What appealed to him was that it was based on the examination of small areas on which this multiple agriculture of ours was built.

He himself had studied agriculture in Canada, Denmark and the United States. It was nothing like our own with its extraordinary variety and its local activities which could only be resolved in the terms which the author had proposed. He hoped he would go on with it area by area, and by his careful analyses help to prevent the former dismal conflict between agriculture and industry and point to a healthier relation between the two. But that was bigger than the problem of dispersion.

PROFESSOR SARGANT FLORENCE said that he would avail himself of the privilege of replying in more detail in the *Journal*. He wished to make it quite clear that he was not advocating dispersion. He left that to the Barlow Commission and the Scott Committee. But it looked as though part of the Government policy was in fact going to be one of dispersion of factories from congested areas. His own rôle was merely to suggest suitable and efficient application of such plans for dispersion, if and when the Government adopted that policy.

He also drew attention to the fact that a good many of his tests were an

attempt to limit dispersion. For instance, there was the question of size of factories. It was not usually considered desirable to have factories too big, either in country areas or small towns. He had been afraid that somebody would complain that he had selected so few industries—only 30 of them—that the whole dispersion policy was vitiated. This list was really a very small proportion of all the industries that various planners had thought of for dispersion. There was a general cry of "Let's have that industry" and "Let's have this." In fact his conclusions formed a rather severe limitation on dispersion. Moreover, it must not be thought that the first paragraph was merely an introduction. It was a summary of work done in the University of Birmingham and endowed by the West Midland Group for Post-War Reconstruction and Planning in limiting the places where industries were to go. A large area of the Region was to be preserved for agriculture or for recreation. This was by no means an attempt to industrialize the whole of Great Britain.

As for taking a static view, unfortunately statisticians could here not look at the past and thus get a trend statistically, because in England the industrial classification kept on being altered. The civil servant was a conservative except in the way he altered his classification every ten years. The result was that one decade could not be compared with another. He spoke feelingly, because in America this was possible. In America he had invented an instrument called the coefficient of redistribution, measuring the change of industrial location every decade. But that could not be done in this country. Nor, apart from tracing the trend, could he invent statistics for the future, and that was why he had said in conclusion that statisticians had to call in the expert to deal with the new developments in technique and to say where these developments were going to lead them. Unfortunately, the expert was too often either a narrow specialist in one industry, or else, if he knew something about a lot of industries, he was usually too busy to give his mind to a particular case. Both in America and in this country it was desired to know what the future of certain industries would be, but it was difficult to get an expert opinion.

He did not know how far he ought to deal with details. Something had been said about agricultural machinery. The components of such machinery might be made in towns, but the assembly might be easily carried out in the country where the finished product was to be used. Certainly it would be excellent if the Census of Production were to distinguish repair and assembly separately.

Mr. Kendall's points had been very interesting. The reason why they had to take regions as the basic area was because the Census of Production only gave them regions. The Census of Population gave smaller areas. The smaller the area, he thought, the better, and though involving lengthy calculations it would be worth while to work out the coefficient of localization based on the smaller areas of the Census of Population. To show that these coefficients were not "absolute," he had deliberately divided column 13 of Table A into "a" and "b" sections. Both these sections gave coefficients of localization, but one was on the basis of the Census of Production Regions, and the other on the Census of Population Regions, but not the smaller areas. The two coefficients occasionally differed very much, though it was surprising how seldom, considering that the two Censuses had different systems of regions and a different classification of industries. It would readily be seen that there was a wide diversity, but not so wide that the two figures would not normally put the industry into the same grade.

He agreed that "plus," "minus" and "nought" were too few grades. Five or six grades would be the sort of thing he wanted to use. Table B, however, was intended only as a very general guide to planning authorities. If they wanted something more detailed, they could refer back to Table A, and use their own weighting for each column and grade as fine as they liked.

In conclusion he wished to say how much he appreciated the help forthcoming in the discussion. This was a pioneer effort. He believed it was the first paper of its kind, and it was put forward in order to see whether it was

worth while going on with this kind of study. But he was encouraged that this sort of work was worth doing.

PROFESSOR FLORENCE later wrote as follows:—

The comment that should be met in greater detail is Mr. Kendall's "point of great theoretical interest" raised by the coefficient of localization.

I am very grateful to him for bringing up the basis of this very fundamental measure. In summing up I said that the coefficient of localization should be based on a division into as many areas as possible. I use the sixteen regions which is all the Census of Production gives us. Grouping these areas into fewer and fewer areas certainly reduces the coefficient ultimately to 0, for the simple reason that if there is only one area, there cannot be any deviation from it. But it does not follow from this that splitting areas up more and more will ultimately make the coefficient unity. For many occupations no amount of splitting up areas will produce a condition of affairs in which all persons pursuing that occupation are in one area only and no other occupation whatever is found there—which is the condition measurable by a coefficient approaching close to unity. Trials I have made show that once a certain minimum number of areas are taken, coefficients of localization based on a larger number of areas do not show much larger values. Baking, shopkeeping or transport will still be found dispersed in all areas, thus showing a low coefficient, and these occupations will continue to be sharply distinguished in pattern of location from localized industries showing a high coefficient of location. It is therefore quite fallacious to say with Mr. Kendall that one could get any value of the coefficient one pleased merely by choosing one's modifiable geographical areas.

In any case, the same standard areas were used throughout—the regions, namely, given by the relevant Census—and not any areas chosen *ad hoc*. To make this clearer it might perhaps be an advantage to speak of this measure as the coefficient of "regionalization."

Finally, I should like to thank Mr. D. G. Champemowne for a suggestion, made after the meeting, towards improving the index of the amplitude of the trade cycle. In order to eliminate the general trend of an industry's growth or decline, the drop in employment in 1932 is best compared not just with employment in 1929, but with the average of employment in 1929 and 1935. This column—8—was not referred to in the discussion, so that I have felt at liberty to change the figures appearing originally, in the interests of more significant measurement. The changes as a whole make a positive assessment for rural dispersion more difficult.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society:—

Horace Edmund Browning, B.Sc.(Econ.).

Geoffrey Crowther.

Margaret Reid Mann.

William Morris.

Ernest Vivian Talbot.

Thomas Charles Williams, B.Sc.

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Corporate representatives

John Richings James *representing* The Geographical Section, Admiralty.

Donald Tyerman; R. E. Bird; Mrs. R. L. Desbrow; Mrs. V. Andrews; D. O. Self; *representing* "The Economist" Newspaper.

Mary Jaqueline Tyrwhitt, *representing* The Association of Planning and Regional Reconstruction.

MISCELLANEA

SAMPLING METHODS FOR THE MEASUREMENT OF FRUIT CROPS

By S. C. PEARCE

(East Malling Research Station)

IN the statistical examination of the results of experiments on fruit trees the newcomer often comments on the many records that are ordinarily made. Experimenters require information about the size and rate of growth of their trees, the incidence of pests and diseases, the condition of the ground, the dates and extent of blossoming, the degree of frost damage and much else, but most important of all are the records of the actual cropping of each tree in each year. The National Fruit Census of January 1944 shows the East Malling Research Station to have 18,539 trees, most of which are experimental and require an individual record of crop; so it will be appreciated that this is a task of no small magnitude, especially since it has to be compressed into a few months. The development of sampling methods has thus become essential.

A preliminary report has already been published (Pearce, 1943) on the estimation of total crop and fruit size for apples. It is the purpose of this present paper to review and complete that part of the work, and to extend the methods evolved to pears and plums. Among previous work on the subject may be mentioned the papers of Edgar and de Wet (1935) and Hoblyn and Edgar (1938).

ESTIMATION OF TOTAL CROP

Introduction. The total crop of a fruit tree is a very variable quantity. For apples it may occupy anything up to twenty bushel boxes of 40 lb. each, for pears up to five such boxes of rather more than 50 lb. each, and for plums up to sixteen chip baskets each holding about 12 lb. The chief object of sampling is to reduce the number of weighings, and this can be done if a uniform type of container is used, since the crop can then be well estimated by counting the number needed for each tree. Where the last box is incompletely filled, a reliable estimate of the weight may be obtained by measuring the depth of fruit in it.

No information has been sought on the subject of pears, since in Great Britain they do not often give a crop much in excess of two bushels a tree, and a full record can therefore usually be made with only one or two weighings.

Sources of Variation. It is evident that the weight of fruit in a box or basket is subject to two kinds of variations, (i) that between trees, of which the variance will be written, V , (ii) that between containers within trees, with variance, U . In order to evaluate these variances, eight trials were carried out, the results of which are given in Table I. Two containers were selected at random from each tree, and the contents weighed. The results were then examined by the method of the analysis of variance, the variance between trees being equated to $2V + U$, and the error variance to U . The value of V will, of course, depend on the nature of the treatments applied, since they may cause big differences in fruit size; and such differences affect the weight of fruit it is possible to get into a box. Thus it is easier to fill a box completely with small fruits than with large ones. It is also possible that the treatments may affect the specific gravity of

the fruit, a point investigated, but not published, by the late Dr. R. C. Knight, whose papers have kindly been placed at the disposal of the present writer by Dr. M. C. Vyvyan. From this data it appears that large apples of Lane's Prince Albert have a significantly smaller specific gravity than small ones, thus reinforcing the packing effect. A set of treatments giving fruit of widely different sizes is, therefore, likely to give a large V . All the trees here examined, except the Barnack Beauty apples, came from rootstock trials, and the consequent differences in fruit size were not exceptionally large.

TABLE I

Variation of the weight of fruit in a container, as measured by the variance between trees (V) and within trees (U)

Variety			No. of trees	Mean weight, lb.	V	U
Apple.	*Lane's Prince Albert	...	295	37.8	1.83	3.90
	*Barnack Beauty	...	122	40.0	1.04	4.52
	†Allington Pippin	...	70	38.7	1.76	5.13
	*Bramley's Seedling	...	61	43.8	1.20	5.02
	†Victoria	...	99	12.5	0.66	1.45
Plum.	†Cluster Damson	...	39	13.4	0.31	1.49
	†Purple Egg	...	36	13.5	0.60	1.89
	†Czar	...	35	13.8	0.17	2.50

* 1942 crop.

† 1936 crop.

The weight of apples in a box varies considerably from one variety to another, partly because fruits of different shapes pack differently, and partly because of the varying proportions of intercellular volume, shown by Smith (1938). Fruit of different varieties should, therefore, always be sampled independently, and the same procedure may prove advisable for treatments that greatly influence fruit size.

Methods of Computing. If one box or basket has been taken at random from each tree of a plantation and the contents weighed, there are three methods of computing the crop of any given tree. (i) Taking the average of all weighed containers and multiplying the number of containers from the tree by this value. (ii) Using the known weight of the box or basket actually recorded, and the general mean for the rest. (iii) Multiplying the weight of the sample container from that tree by the number of containers. It has previously been pointed out (Pearce, 1943) that the sampling variances of the three methods are:—

$$(i) \ n^2V + nU \quad \dots \quad A$$

$$(ii) \ (n-1)^2V + (n-1)U$$

$$(iii) \ n(n-1)U, \text{ where } n \text{ is the number of containers.}$$

From these expressions the relative merits of the three methods may be deduced. It will be seen that the second method is always better than the first, and also better than the third, since V is less than U . On the other hand, it is more trouble to compute, and this would be worth while only when the additional accuracy was essential. Of the other two methods the first is recommended when n is greater than, or equal to, three.

Of all linear estimates of total crop the one with the least variance is obtained by multiplying the weight of the container actually recorded for the tree by $\frac{nV + U}{V + U}$ and adding the product of the general average and $\frac{(n-1)U}{V + U}$. Proceeding in this way the sampling variance is $(n-1)^2 \frac{VU}{V + U} + (n-1)U$, and it will be seen that for values of n less than six or eight the second method is very nearly as good as this optimum method.

The Method in Practice. A rough rule for the experimenter is that V and U are 1.6 and 4.8 respectively for apples, and 0.45 and 1.8 respectively for plums. He could also assume that his estimated crop weight will differ from the true value by less than twice the square root of the appropriate sampling variance. Working in this way, he would be wrong about once in twenty times—more often with a variable field, less often with a uniform one—but averaging about that proportion of mistakes over a year's cropping. Using these standard values and the second method of computing, it can be shown that these sampling limits never exceed 7 per cent. of the total crop for apples, or 13 per cent. for plums, so that the accuracy, if not great, is sufficient for many purposes.

The Case of Few Weighings. The above work has proceeded on the assumption that the general average used in the first and second methods is determined from so many trees that its error may be neglected. Sometimes, however, there are not many trees on the plantation, or it may be necessary to reduce weighing to a minimum. If the general average has been calculated from only a single box from each of k trees, the sampling variances are as follows:—

First method, the tree being one of those from which a sample box or basket was taken.

$$n^2 \left(\frac{k-1}{k} \right) V + n \left(\frac{n+k-2}{k} \right) U.$$

First method, the tree not being one of those from which a sample box or basket was taken.

$$n^2 \left(\frac{k+1}{k} \right) V + n \left(\frac{n+k}{k} \right) U.$$

Second method.

$$(n-1)^2 \left(\frac{k-1}{k} \right) V + (n-1) \left(\frac{n+k-1}{k} \right) U.$$

Given a large plantation, the decision has to be made whether to take a sample container from each tree or only from a random selection of them. The number that will have to be taken depends on the number of containers filled by the largest crop ($n_{\max}$), and the greatest proportional increase (θ) that can be tolerated in the sampling variances. From the above work it can be shown that the number of boxes of apples needed is $\frac{4n_{\max}}{\theta(n_{\max} + 3)}$, since $U = 3V$. (The method of computing is of necessity the first, and there is the possibility that some of the trees with a maximum crop will not be among those chosen for the estimation of the general average.) For plums, where $U = 4V$, the expression is $\frac{5n_{\max}}{\theta(n_{\max} + 4)}$. To take an example, suppose the maximum crop of any tree in an apple orchard is seven bushels ($n_{\max} = 7$), and the sampling

variance for any tree is not to exceed the value derived from the expression marked A by more than 10 per cent. ($\theta = 0.1$); then it will be necessary to weigh one box from each of 28 trees.

ESTIMATION OF FRUIT SIZE

Apples

Evolution of the Method. Fruit size of apples and pears is usually measured by dividing the total weight by the number of fruits, unless mechanical grading is resorted to. Fruit counts of large crops are laborious for apples and pears and impossible for plums, so a sampling method is essential.

The first decision that has to be made in devising a sampling method for fruit is whether to make the selection before or after picking. After picking, the boxes are always stacked at once, to prevent the sun harming the crop. Consequently selection involves taking down the stacks and then building them again, a task that is often beyond the powers of the women recorders. This may also cause delay in marketing or storing the fruit. It is, however, extremely difficult to select fruit, while it is still on the tree, without introducing a bias. The eye is attracted always to the obvious or brightly coloured fruits, and on most trees there are small green apples, which must be fairly represented in the sample. Nor can any natural division of the tree be picked separately, for these small fruits are to be found near the bottom rather than at the top, and inside rather than outside. However, the picker is influenced by these factors no less than the would-be sampler. He takes up various positions round the tree, and begins with the more obvious apples each time. The consequence is that successively filled boxes would be expected to show by their variation where the picker had changed his position, and the whole might well show a trend. It follows that a sample drawn at regular intervals through a picking would be representative of the crop, since a picker's changes of position follow no regular rule, while the presence of a trend would actually increase the accuracy.

The method evolved was as follows: Arrange for the boxes from each tree to be stacked in threes *in order of picking*. This is a convenient number, since few care to lift a fourth bushel box on to such a stack. The top boxes of complete stacks now represent regular insertions into the crop, and can be examined quickly without any disturbance of the piles.

The next decision concerned size of sample. The standard weighing apparatus was designed for bushel boxes, and it was thought desirable to reduce recording to one weighing for each tree with a minimum of counting. Accordingly, for each plantation the number of fruits that would in general make up three-quarters of a bushel was determined, and that number taken from each tree, dividing it equally between the tops of stacks. In this way the sample rarely exceeded one bushel, and was counted while it was being drawn. It was found convenient to choose a multiple of 60 wherever possible, because of its many factors. The obvious disadvantage of this procedure is that a box with large apples contributes more than a box with small ones, and consequently the sample will tend to over-estimate the mean size of fruit. It is also likely that very small fruits tend to be shaken towards the bottom of the boxes, and are therefore missed by the sample. It was first supposed that the method

would be at best very rough and the bias lost in the error; but happily the method proved much better than was expected.

Trial of the Method. The reasoning outlined above was really derived from a process of trial and error, the full story of which has been told elsewhere (Pearce, 1943). It remains to state the results of some empirical trials undertaken during 1942 and 1943, in which these rather speculative conclusions were put to the test. The procedure throughout was to take a sample, and then to count and weigh the remainder of the crop, in order to be able to compare the sample value with the true value. At that time there were doubts whether it was safe to space the parts of the sample as far apart as three bushels, and in most of these trials a closer spacing was employed. The results are set out in Table II, in which the error column shows the standard deviation of the sample value from the true value expressed as a percentage of the mean true value for the variety. In comparing the sample spacing with the mean crop, it might appear that for some varieties the sample had not been divided at all, but was

TABLE II
Details of sampling and consequent errors with apples

Variety			No. of trees	Mean crop, bush.	Sample spacing, bush.	Mean "true value," lb.	Error, %
Culinary.	*Lord Derby	...	12	4.0	1	0.334	8.1
	*Early Victoria	...	4	4.4	2	0.198	6.4
	*Grenadier	...	13 ‡	3.2	2	0.297	4.9
Dessert.	*Miller's Seedling	...	20	4.8	2	0.105	4.7
	†Barnack Beauty	...	24	6.2	3	0.191	3.0

* 1943 crop.

† 1942 crop.

‡ Excluding one tree, on which it is thought that the weight of the sample must be in error by 10 lb.

always taken from one box. Actually crops from a plantation are usually rather variable, and it is not difficult to find trees having crops of twice the mean. Thus the 13 Grenadiers examined included one tree with 6.1 bushels, while some neighbouring trees had to be excluded as not giving a crop large enough to sample. Where the sample could not be divided, the total crop was small, and three-quarters of a bushel, however selected, represented quite an appreciable part of it.

The culinary apples gave less satisfactory results than the dessert apples, and the errors are very closely related to the variability within the varieties. Barnack Beauty, for example, is an exceptionally uniform variety, while Lord Derby is rather a variable one.

Sample Spacing. Eighteen trees of Worcester Pearmain with a mean crop of 2.8 bushels were used to test sample spacing. On six the sample was divided between the tops of alternate boxes, on six the tops of all boxes were used, and on six the sample was taken as a vertical section through the boxes. The resulting errors were 2.9, 3.3 and 2.5 per cent. respectively, from which it was argued that the increase in error due to wider spacing could hardly be very large. This was confirmed by sixteen trees of Allington Pippin with a mean crop of 5.9 bushels, of which half were sampled using the top boxes of stacks of three,

and the rest using every box. The errors were 5.4 per cent. and 5.7 per cent. respectively. The enormous advantages of not having to unstack boxes have already been explained.

Sample Size. The sample of three-quarters of a bushel, like the spacing, had been chosen only for convenience. To test its adequacy, sixteen trees of Laxton's Superb, giving a mean crop of 3.7 bushels, were sampled with a spacing of two bushels, the sample being drawn in two equal parts. The error of three-eighths of a bushel samples was 6.4 per cent. and of the full samples 5.1 per cent., the mean size being 0.156 lb. Twelve trees of Blenheim Orange having a mean crop of 5.6 bushels were similarly sampled with a spacing of three bushels, and the reduction in error with the full sample was from 9.0 per cent. to 5.3 per cent., the mean size being 0.321 lb. It seems, therefore, that the adopted size of sample cannot well be reduced, and where close comparisons are desired it may be advisable to increase it.

The Bias in Sampling. Considering now the bias, it was found that in 47 of the trees of Table II the sample value was greater than the true value, in only 22 it was less, while in four trees the sample gave the true value exactly. By the Binomial Theorem this result is likely to arise by chance from an unbiased method only once in 800 times, so the result must be judged to be significant. It will be seen that if this bias is entirely the result of boxes with large fruits contributing more than those with small ones, it will not exist where the sample has been drawn from only one box. The data did not suggest that the bias is much reduced when the sample is undivided. If, however, the bias is the result of the small apples slipping down between the larger, it will increase with mean fruit size. The smallest fruit of any variety are usually about the same size, and any excess of mean size over this minimum might result in bias. For the five varieties referred to in Table II and the two used in the testing of sample size the biases were: Lord Derby, + 0.0137 lb.; Blenheim Orange, + 0.0127 lb.; Grenadier, + 0.0062 lb.; Early Victoria, + 0.0035 lb.; Miller's Seedling, + 0.0023 lb.; Barnack Beauty, + 0.0001 lb.; and Laxton's Superb, - 0.0026 lb. From these results it seems probable that bias increases with fruit size above about 0.2 lb., and may be neglected for smaller fruit. Also, partial regression coefficients were estimated for the deviation of the sample value from the true value on total crop weight and mean size, and suggested that bias is chiefly dependent on the size of the fruit. Consequently it could probably be eliminated by taking the sample as a vertical section through the crop, but this procedure is so much more laborious that it was not seriously considered.

On account of this bias, the sample value cannot strictly be used as an estimate of the true value. However, the method is intended for the discovery of differences between the treatments of an experiment, and here a constant bias is of no importance, while a uniformly increasing one merely "stretches" the scale of measurement. The fact that the bias only really begins to operate for fruits of more than 0.2 lb. in weight is, of course, a disadvantage, but probably not a serious one, since extremes of fruit size are not usually found between trees of the same variety from the same plantation. The bias being variable, it follows that a standard error calculated from sample values should not be referred to true values. All that is claimed for the method is that it provides a means of obtaining data for fruit size to which the method of the analysis of variance may be validly applied for the determination of genuine differences. As a means of precise estimation it is admittedly defective.

Pears

Adaptation of the Method. In sampling pears the chief difference from apples arose in the matter of sample spacing. The less compact shape of pears would make it more difficult to take a section through the crop, even if it were shown to be desirable; while the tendency to give smaller crops made it unnecessary to investigate the effect of dividing the sample between the tops of full stacks. Accordingly all samples were divided between the tops of all full boxes. Variability was, on the whole, less than with apples; and with one variety. Fertility, less than half a bushel was taken from each tree, the results being quite satisfactory. The results are set out in Table III.

TABLE III

Details of sampling and consequent errors with pears (1943 crop)

Variety	No. of trees	Mean crop bush.	Mean "true value," lb.	Error, %
Beurré d'Amanlis	31	2.9	0.224	3.5
Pitmaston	16	2.1	0.419	2.0
Fertility	14	1.9	0.172	2.5
Conference	12	1.5	0.327	3.5

Adequacy of the Method. When to these results were added the records of fruit size on two comparable trees with crops too small to sample, the Beurré d'Amanlis trees formed eight randomized blocks of four treatments, the Pitmaston four such blocks and the Fertility four such blocks with a missing plot. These data were dealt with by the method of the analysis of variance, and the resulting error variances are set out in Table IV. No appreciable increase in

TABLE IV

Error variances (multiplied by 10⁶) from randomized block data using true values and sample values—Pears

Variety	d.f.	Error variance	
		With true values	With sample values
Beurré d'Amanlis	21	582	609
Pitmaston	9	2113	1686
Fertility	8	585	560

variability was brought about by the use of sampling, and it follows that the method is a good one, provided that the bias is of no importance. Of the 73 trees in Table III, 45 gave sample values greater than the true value, while 26 gave a sample value that was lower. This bias, however, should not influence treatment differences.

Plums

Introduction. The sampling of plums is a problem markedly different from those that have already been discussed. The plum is a smaller fruit and is usually picked into smaller containers. Further, it is commonly found in clusters unless thinned, all the fruit in a cluster being about the same size, while speed is even more essential so that the fruit can be marketed the day it is picked. In 1939 sixteen trees of Purple Egg, giving about eighteen fruits to the pound, were sampled. From each tree two 12 lb. chip baskets were chosen at random, and from one of them plums were counted into the pan of household scales until 1 lb. was reached, then the numbers to make up 2 lb., 4 lb., 6 lb., 8 lb. and 10 lb. were recorded in the same way, thus forming the "first sequence of samples." A second sequence was obtained using the second basket in the same way.

In 1943, sixteen trees of Czar (giving about 25 plums to the pound) were also sampled. Precisely the same records were made except that one basket was

TABLE V

Variances between trees of a pair, using the numbers of fruit to a pound as determined by different kinds of samples

Size of sample	1 lb.	2 lb.	4 lb.	6 lb.	8 lb.	10 lb.
1939.						
First sequence ...	8.00	4.12	3.57	3.49	3.58	3.90
Second sequence ...	5.56	2.94	2.95	2.90	2.48	2.58
Both sequences ...	—	5.86	2.39	—	1.77	—
1943 (16 trees).						
First sequence ...	10.31	5.20	5.31	4.51	4.82	4.44
Second sequence ...	1.56	1.50	1.19	2.76	2.67	3.33
Both sequences ...	—	2.25	1.21	—	1.57	—
1943 (40 trees).						
First sequence ...	5.27	3.34	3.24	—	—	—
Second sequence ...	3.35	3.23	2.43	—	—	—
Both sequences ...	—	2.12	1.42	—	1.51	—

chosen at random from the work of each of the two pickers on the tree. In addition to these trees another 24 were used to give the numbers of fruit in 1 lb., 2 lb., and 4 lb. only, again in two sequences from two baskets a tree.

Variation within a Picking. To determine whether any sample of 2 lb. from a tree was equivalent to any other sample of 2 lb. the results were summarized to provide the numbers in successive samples of 2 lb. from each basket, and then examined by the method of analysis of variance. It was found that the plums were somewhat smaller at the bottom of the basket, this effect being significant at the level, $P = 0.05$, in 1939, and at the level $P = 0.001$, in 1943. The actual figures in the later trial were 48.2 fruits for the top sample and 50.5 for the bottom one. This can hardly arise from a picking trend, since there seems to be no reason why the smaller fruit should be taken first; and is probably the result of the smaller plums being shaken to the bottom through the spaces between the larger ones. It follows that a sample taken from the tops of baskets will slightly over-estimate the size. In 1943 the difference between sequences within trees was significant at the level, $P = 0.001$, and it would therefore be advisable to divide the sample between several chip baskets.

Size of Sample. In Table V are set out the results of a uniformity trial to determine the best size of sample. It shows the variance between trees of a pair as represented by different kinds of samples. Since the experiments were laid out in pairs of adjacent trees of similar origin and history, the inherent variation between trees should be a minimum. If, therefore, a sample gave an error that was lost in this inherent variation, it should be sufficiently accurate for most purposes. It will be seen that there is not much to be gained by increasing the sample size above 2 lb., and hardly anything by taking more than 4 lb. The table shows also that the divided samples were better. A difficulty that sometimes arises with data of this kind is the association between successive samples of a sequence, since the larger ones include the smaller, and the results for the second sequence of samples from sixteen trees in 1943 clearly show this effect. Fortunately, over the range where these anomalous results occur, the larger set of trees provides a check.

Recommendation. From these results it is recommended as a general rule that a sample of from two to four pounds be taken, divided between at least two containers. It is difficult to suggest a standard procedure, because plums are picked into so many different kinds of boxes, sieves and chip baskets, and give crops of such greatly varying sizes. However, it should generally be possible to take a sample of 60 fruits, divided equally between three containers, and to weigh it to the nearest 0.1 lb. When this is not convenient, the general rule will usually suggest an alternative.

DISCUSSION

The methods here recommended have been evolved largely under pressure of war-time conditions, and it is not suggested that they can wholly replace the complete records that have previously been made. However, it often happens that only rough observations are called for, and these methods seem likely to be sufficient for many purposes. The estimation of total crop by the number of full boxes or baskets is admittedly not accurate enough for precise experiments, but it is doubtful whether it will ever be necessary to go back to the laborious weighing of each container that used to be the standard procedure. It is more likely that a compromise will be found in weighing all containers up to a maximum of two or three to a tree. The methods of estimating fruit size are a more notable advance, because a complete record is so difficult to make. For apples the standard error was about 5 per cent. of the mean. Since this figure was obtained without correction for the bias, limits of sampling obtained by doubling it would be over-estimated*; and it may be concluded that the sample value will be correct to within 10 per cent. of the true value more than 19 times out of 20. When these limits are exceeded it will mostly be on the high side. For pears the method will be correct to within 7 per cent. on at least 95 per cent. of occasions, and there seems to be no need to seek further; while the method suggested for plums is but a systematization of the previous practice, and gives better accuracy with no additional labour.

* If the bias be β and the sample values be distributed normally with standard deviation σ , then the standard errors in Table II represent $\sqrt{\beta^2 + \sigma^2}$. Referred to the mean of the normal distribution the suggested limits are $-2\sqrt{\beta^2 + \sigma^2} - \beta$ and $2\sqrt{\beta^2 + \sigma^2} - \beta$, which cut off less than the 0.0455 of the total area usually associated with limits of $\pm 2\sigma$. Without a knowledge of β/σ it is impossible to go further, but the limits are only given as approximate.

ACKNOWLEDGMENTS

The writer would like to thank Mr. T. N. Hoblyn for his advice on many matters, and also Dr. A. B. Beakbane and Miss E. M. Glenn for their co-operation in arranging the necessary recording. The 1939 plum trial was partly the work of Mr. W. Rudoe, while Mr. J. R. Wormald gave valuable service in 1943 by superintending the work during the occasional absence of the writer. He would also like to thank Mr. J. Floor for the gift of a numerical diagram designed to facilitate the calculation of fruit size, a description of which is in preparation. Finally, his thanks are due to the recording staff, who undertook the unfamiliar work with such efficiency and accuracy.

SUMMARY

It is shown that it is possible to estimate the weight of an apple or plum crop with very fair accuracy by counting the number of boxes or chip-baskets into which it is picked. A discussion is included on methods of computing, and the least number of sample containers that need to be actually weighed.

Methods are given for estimating the mean size of fruit in crops of apples, pears and plums for the examination of treatment differences. For apples it is recommended that a sample of three-quarters of a bushel be divided equally between the tops of complete stacks of three bushels, for pears that a similar sample be divided between all full bushel boxes, and for plums that a sample of 60 fruits be divided between three containers chosen at random.

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REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*The Advanced Theory of Statistics*. By Maurice G. Kendall. Vol. I. London: Charles Griffin, 1943. 10" × 8". xii + 457 pp. 42s.

There is evidence that during the last twenty years more than one person has braced himself for the effort needed to write a book which would do justice to the mathematical theory of statistics, but for one reason or another these plans have never been completed. Now, at last, Mr. Kendall's forceful energy and, one may perhaps add, his sense of passionate discontent with the situation which has faced the advanced student, these have seen the job through. There were, no doubt, good reasons for this hesitation in others to commit themselves in print; the past twenty-five years have witnessed a vigorous jostling and development of ideas, such that the teacher of statistics had found that his lecture notes for one year's course needed substantial modification a year or two later to keep pace with rapid advances in technique and to conform to his own development in outlook.

A difficulty which the would-be text-book writer has had to face is the choice between what Mr. Kendall terms in his Preface the logical and didactic methods of approach. The order of presentation he has chosen himself is of some interest: two relatively elementary chapters (1 and 2) introduce the idea of a frequency distribution and of measures of location and dispersion. Next come two chapters (3 and 4) dealing with moments, cumulants and characteristic functions. These are followed by two chapters (5 and 6) on the properties of standard distributions, including the binomial, the Poisson, the hypergeometric and the normal distributions and the curve systems of K. Pearson, Edgeworth and Gram-Charlier. Probability, likelihood and random sampling are discussed in the next two chapters (7 and 8). Then follow a group of three chapters on derived sampling distributions—i.e., on standard errors and large sample theory (9), on the derivation of exact sampling distributions (10) and of approximations to sampling distributions (11). This last chapter gives a very full account of the sampling cumulants of k -statistics. There is then a chapter (12) on the χ^2 distribution and its uses. Finally the volume concludes with four chapters (13–16) on various methods of measuring correlation. Short tables relating to the normal probability integral and to the t , z and χ^2 distributions are added.

It is understood that Volume II will contain chapters on single valued and interval estimation, tests of significance, regression analysis, analysis of variance and sampling design, the theory of testing statistical hypotheses, multivariate analysis and time series.

In describing this approach as logical Mr. Kendall means, I presume, that the mathematical framework is built up in an orderly way, each step providing the tools required later on. This is the justification for devoting two of the very early chapters to a full treatment of moment, cumulant and characteristic function theory. It must also be accepted as the reason for leaving to Volume II the greater part of the discussion on how the theory is best applied—i.e., the chapters on estimation and testing statistical hypotheses. While the basic mathematics can be established beyond dispute, the question of how best to use the mathematical model as a guide to practical decisions is one which is always likely to be subject to personal opinion. Part of this subject is therefore, as Mr. Kendall says, controversial, and may not fit readily into the solid and impersonal presentation required in a mathematical text-book.

It seems to me that Mr. Kendall's achievement is to have presented for the first time, in admirable form for reference, the mathematical framework of our theory. Thus, he has provided a book which will be invaluable in the advanced teaching course, since by directing the student to appropriate chapters on theory the teacher will be freer than he has ever been before to tackle the difficult problem of training the mathematician to apply his knowledge soundly in interpreting the numerical data of practical experience. The book will also be welcomed by those of us whose theory has become somewhat rusty and who want to find a clear re-statement in one place of a particular branch of the subject which hitherto it has been necessary to track down in back issues of a number of scientific journals.

There is, however, another class of reader who should not be forgotten. At the present time there are likely to be many persons beyond the reach of university training who will take up the study of mathematical statistics; indeed, through its recent Reports as a plan for the Diploma, the Society has been encouraging this step. There is also the case of the lecturer in mathematics who hopes, by reading, to qualify himself as a teacher of mathematical statistics. Is Mr. Kendall's approach that best suited to help this type of reader? The question is an interesting one because of its bearing on the broader problem of how best to teach statistics. Clearly no final answer is possible. Volume II has appeared, but I am inclined to think that the mathematician who reads Volume I without guidance may be left with a somewhat unbalanced view of the practical function of mathematical statistics.

The problem with which teachers of mathematical statistics are faced is that of training the mathematical student so that he may turn a sure hand to the scientific analysis of numerical data. The most important qualification of the good mathematical statistician is not the extent of his knowledge of statistical mathematics but his appreciation of the difficulties involved in fitting a mathematical model to the observations of actual experience. He must be clear-headed and self-critical, never letting his knowledge of theory run away with him; he must be always on the look-out to see whether the assumptions upon which the mathematics and probability theory have been constructed are, in fact, realised in practice, and, if not, whether the discrepancy will vitiate his conclusions. He should never employ a complex technique until he is clear in his own mind that it provides more accurate and useful information than a simpler method. And he should remember how often the most illuminating first step in the analysis of data is to examine them in appropriate diagrammatic form.

During this war mathematicians, physicists and biologists have done their best to fill the gap which has resulted from an inadequate supply of mathematical statisticians. Many of them have taught themselves to become useful working statisticians, but it has been noticeable that when they have gone beyond the use of the simpler methods, they have often shown a lack of critical sense and have embarked on lengthy calculations which have been unjustifiable and likely to end in misleading conclusions. I think that this has occurred because the available text-books have rarely been so written as to encourage the critical faculty. And with all its admirable qualities as a reference book, is it clear that Mr. Kendall's Volume I is altogether free from this defect?

I put this as a question, aware that I may be demanding the impossible in a primarily mathematical text. A few examples will illustrate the points that have struck me. I feel that the author is more than once faced by a dilemma of his own making because he has introduced the mathematical theory before he has discussed the problems which it should be developed to solve. Thus a discussion of Bayes' postulate and that of Maximum Likelihood (7.24-7.31) is inevitably unsatisfactory and inconclusive until we have formulated from the practical point of view the user's requirement for an estimate. If a single value only is wanted, we can surely say straight away that there can be no "best" value, only a number of convenient methods for picking out a plausible value. If it is desired to estimate an interval within which the unknown value

probably lies, then we can devise other methods of determining this according to the user's requirements.

Again, does not the baffling problem of the hypothetical population and the imaginary sampling (8:3) fall into the background if we accept as fundamental the distinction between a conceptual probability theory and the perceptual world of experience in which certain "random happenings" are observed or can be made to occur with frequencies more or less in conformity with the theory. Our purpose as statisticians is to make use of this conformity (never perfect) to reduce as far as possible the frequency with which we make wrong decisions—i.e., decisions that would have been different had more data been available at the time.

On a smaller point, the criticism (2:21) that the coefficient of variation is "hardly suitable for advanced work" because it is affected by "the value of the mean measured from some arbitrary origin" seems a little unjustified. In many practical problems the origin is not arbitrary, but clearly fixed on physical or biological grounds by the type of variable measured, so that the ratio of the standard deviation to the distance of the mean from, say, zero is in fact the relative measure of variation most appropriate. Consequently it is up to the mathematical statistician to find out what he can about the distribution, whether it is suitable for advanced work or not. Again, the range appears to be dismissed rather summarily in three sentences (2:15) without mention of the fact that in a certain broad class of sampling problems its use has proved more expeditious and, from the practical point of view, as effective as that of the standard deviation. Obviously this book cannot be concerned with the quadrature of integrals where there is no neat theory, but I think a reference to the practical value of such tabled distributions would have been worth while.

There are places also where the opportunity might have been taken to encourage a critical outlook in the reader. Thus, in Example 8:9, introducing for the first time the test of a hypothesis, Mr. Kendall takes the case of a coin which is tossed 20 times and gives heads 15 times. He asks whether this conflicts with the hypothesis that the coin is unbiased and bases his answer on the fact that the chance of getting 5 tails or less, if the hypothesis be true, is about 1 in 50. But why sum the chances in the tail of the binomial distribution, the inquiring reader might ask? Why not just consider the chance of getting 5 tails? Is the point too obvious to need explanation, remembering that this is the first appearance of the procedure?

Another point which is here, as elsewhere, assumed as self-evident, yet appears to call for some comment or explanation, occurs in applying the χ^2 test to contingency tables. Why, the reader might legitimately ask, is it stated that the marginal totals may be regarded as constant (12:11, 12:16, 13:5)? In so far as the test is related to a sampling problem, it is a little difficult to regard both margins as fixed or constant and the usual test can, in fact, be established without appeal to this convention.

These are criticisms, but what brother-statistician could be expected to read a book of this scope without coming on many points with which he disagreed! And the disappointments are few compared with the pleasures: the admirable synthesis of scattered work; the inclusion of much of the older useful technique which is apt to be overlooked in the rush for the more attractive "exact solutions" based on the normal distribution; the illustrative examples and the Exercises left for solving; the Notes and References at the end of chapters. At any rate the reviewer is already clear of the value that Volume I will be to him personally when he starts on preparing his first post-war lectures. May printer and publisher soon give us Volume II!

E. S. P.

2.—*The Statistical Study of Literary Vocabulary.* By G. Udny Yule, C.B.E., M.A., F.R.S. Cambridge University Press, 1944. viii + 306 pp. 25s. net.

The word style is not a part of the title, nor does it occur in the index. Nevertheless my first impulse on glancing idly at the preface and early chapters was to consult the shorter *Oxford English Dictionary* and the sister *Dictionary*

of *Quotations*. According to the former, style is "the manner of expression characteristic of a particular writer or of a literary group or period; a writer's mode of expression considered in regard to clearness, effectiveness, beauty and the like." The *Dictionary of Quotations* provided a near equivalent to this with Buffon's "Le style c'est l'homme même." Swift's "Proper words in proper places, make the true definition of a style" is more remote; it is rather Swift's idea of what makes a *good* style. I am tempted to give one more nugget from the mine. George Colman in *Random Records*, 1830, contrasts the styles of Johnson and Gibbon:—

"Johnson's style was grand and Gibbon's elegant; the stateliness of the former was sometimes pedantic, and the polish of the latter was occasionally finical. Johnson marched to kettledrums and trumpets; Gibbon moved to flutes and hautboys; Johnson hewed passages through the Alps, while Gibbon levelled walks through parks and gardens."

Suppose now that we are confronted with a newly discovered work attributed by some to Johnson and by others to Gibbon. Swift cannot help us to settle the question of disputed authorship. George Colman would presumably be able to solve the problem so as to satisfy the O.E.D. definition or Buffon's identification of the style with the man. The scientist feels the need of a more objective test, a test which would yield the same result when competently applied by different investigators. It is the devising of such a test or tests that Mr. Yule has undertaken.

"In endeavouring to obtain an answer to any such question every element of that highly complex quality, the author's style, may and should be taken into account, but among those elements his *vocabulary*—the aggregate of words he uses—takes an important position. It is a definite characteristic, and certain aspects of it at least are susceptible of definite numerical treatment, treatment by what we now call statistical methods."

The numerical study of certain aspects of vocabulary is accordingly the subject-matter of the book. Mr. Yule does not pretend that any of the criteria studied are final, but his results are always interesting, and sometimes fascinating. He begins with the frequency distributions of nouns in samples of an author's work. The mode occurs at nouns used once only. There is a long tail of nouns used many times in extracts with a total number of only a few thousand occurrences. The following is an illustration. A sample of the theological works of the fourteenth-century writer Gerson, shows 8,196 occurrences of nouns. The number of different nouns is 1,754. One noun (*Deus*) occurs 256 times, and 804 nouns occur once only. An extract from Macaulay's "Essay on Bacon" long enough to contain about the same number, 8,045 occurrences of a noun, includes 2,048 different nouns. One noun, this time man, not God, occurs 255 times, and 990 nouns occur once only.

Yule considers that an author has W nouns at his disposal. In any of his writings each noun is exposed to the risk of being not used, used once, twice or any other number of times. The risk is different for different nouns. There is an immediate analogy with the liabilities of factory workers to meet with accidents. The practical application of the Poisson series is, however, necessarily different. In accident distributions we deal with the numbers of workers who in a given period of time meet with 0, 1, 2, 3, . . . accidents. In the study of a piece of writing we observe the number of nouns used 1, 2, 3, . . . times in a "sample" containing a certain total number of noun-occurrences. So long as the meaning to be attached to the words "size of sample" is clearly understood, this difference causes no difficulties. But there is a difficulty in the fact that we do not know how many nouns the author has not used at all. On the basis of the Poisson distribution a characteristic constant is K proportional to $(S_2 - S_1)/S_1^2$, where S_1 , S_2 are the first two moments of the frequency distribution about zero of occurrences of nouns. In the above illustrations if, in order to avoid small fractions, K is $10^4(S_2 - S_1)/S_1^2$, Mr. Yule finds $K = 35.9$ for Gerson

and 27.2 for Macaulay. The square of the coefficient of variation of the liabilities of nouns to occur is $10^{-4}WK - 1$, where W is the number of nouns in the author's vocabulary. This leads Mr. Yule to an interesting section on the probable value of W . He distinguishes between the "number of words an author has actually used in the finite field of his writings" and "the total number of words in the author's 'treasure chest.'" This last is, he thinks, much larger than the estimates usually given of an author's vocabulary. Rough sampling counts show that there are nearly 60,000 nouns in the concise *Oxford Dictionary* and that 32,000 of these (or 23,500 on a stricter basis of rejection of words probably not known to him) were somewhere in Macaulay's treasure-chest, liable to be used if the need was felt and the word came obediently to his mind. Mr. Yule includes a word in an author's treasure-chest if he can recognize it when met, even though it will not come readily when called for. Crossword puzzle addicts will appreciate the distinction. Mr. Yule says, "Our language about the memory is indeed very deficient: there seems to be no term to express the simple existence of a record in the mind, as distinct from the capacity to call up that record at a given time." Of course there may be such a word, and Mr. Yule may know it, but has failed to recall it during the writing of this book!

The starting-point of Mr. Yule's research was a desire to obtain some objective criterion for use in the problem of the disputed authorship of the *Imitatio Christi*. Having introduced the characteristic K , he examines how far it is consistent for different samples of the same size (in the sense used above) for the same author, and how it differs from author to author. Samples from Macaulay's essays on Milton (written when Macaulay was a very young man), Hampden, *Frederick the Great*, and Bacon, give $K = 17.91, 34.09, 21.82$ and (as a mean of six samples for the essay on Bacon), 27.33. The variation in these values *inter se* is not large when they are compared with the values of K for other authors—Gerson 35.9; Thomas à Kempis all works 59.7, *Imitatio* 84.2; St. John's Gospel in Basic English 141.5, in Authorised Version 161.5.

This review is already far longer than I had intended, and reference to many other interesting points in the book must be omitted. The curious reader must find for himself whether the authorship of the *Imitatio* is settled.

The work has a double merit. One of interest to statisticians is the application of statistical method to a new field. The other is that a new field of possible statisticians may be brought in. To achieve the latter end, Mr. Yule has throughout given explanations of methods and processes in sufficient detail to enable the reader who is new to statistical method to follow him. I should have liked to say something of the way Mr. Yule meets and generally overcomes sampling difficulties peculiar to the new field, but I hope I have said enough to show the interesting character of the book and the continuing vitality of the doyen of statistical method.

L. I.

3.—*The Problem of Valuation for Rating*. By J. R. Hicks, U. K. Hicks and C. E. V. Leser. Cambridge University Press, 1944. 95 pp. 7s. 6d. net.

In this volume, which is issued under the auspices of the National Institute of Economic and Social Research, the Hicks partnership has made a notable contribution towards the better understanding of the problems of local finance. The most significant findings are based largely on returns collected at the request of a departmental committee on local valuation, the issue of whose report has been held up by the outbreak of war.* Some question has been raised on the propriety of placing public returns of this kind at the disposal of private research. It is an unusual proceeding, but not therefore to be condemned. There is urgent need for more research, genuine research, in matters of government; there is much to be said for combining private research and public returns, provided there is no breach of confidence; and the experiment has been amply justified in this case.

Valuation for local rating has a long and tangled history. It is the more

* See note at end of this review.

interesting because typical of much in our Island story—the slowness of parliament in dealing with obvious ills, a failing, however, not without some counter-advantages; the trust in local sense (or the want of it); the broad toleration of local diversities; the reliance on the judiciary for removing obscurities and overcoming difficulties, with the judiciary almost unavoidably adding its own quota of confusion because it has to decide on the circumstances of individual cases. It is little wonder if local valuation became a matter of mystery, and, in places, almost of idiosyncrasy.

All this was not of great moment so long as local services were few and local burdens light—though it has to be remembered that, even before the beginning of modern reforms in the 1830s, many parishes were sorely burdened during the years of the Napoleonic wars and later by the incidence of poor relief, with rates approaching, and a few even exceeding, 20s. in the £. The reforms brought more services and higher rates, slowly at first, accelerating in the middle years of the century and much more so in its closing years and afterwards. The setting up of county councils brought a new urgency into the need for reforming local valuation, once those councils got into the stride of their constantly expanding functions, for their financial requirements had to be met by the several contributory areas substantially in proportion to the rateable value of each. How important this has become is indicated by the fact that, whereas towards the end of the last century the total expenditure of all the county councils (excluding London, with its special conditions) was less than half the combined expenditure of all the borough and urban and rural district councils within the counties, by the years before the war the former total actually exceeded the latter.

Another factor has appeared in the meantime to add to this new urgency—the much larger central grants for local services, the probability (certainty rather) of still more substantial increases, and the demand that a larger proportion shall be distributed in proportion to local needs, not just to expenditure.

Governments were by no means blind to the failings of local valuation during these years. London was dealt with at a comparatively early date: the problem there was simpler, and the appointment of an authority with certain functions for the whole of London, the Metropolitan Board of Works, made general uniformity more necessary there than elsewhere. For the country as a whole, the records of parliament are strewn with proposals for better valuation, and better rating, which failed to ripen into law. The Union Assessment Committee Acts of the 1860s produced some improvement, largely by setting up a committee in each poor law union for the general oversight of parochial assessments. It was not until 1925 that another vigorous attack was made on the stubborn problem, this time, it was hoped with some confidence, a really successful attack. Responsibility for the initial assessments were placed on the sanitary authorities, union committees were replaced by county committees for general oversight though with but limited powers, and, a new move, a central committee was set up to advise and to guide but, here too, without teeth to compel. Again there was improvement, but the back of the problem remained unbroken; so much so that the hope of the central committee for a big forward move in 1937–8 had to be abandoned and the department committee was appointed, once more to survey the already much surveyed.

Much about these and many other matters will be found in the present volume, including the confusion unavoidably brought into a situation already very confused by the rent controls of the last war, the partial decontrols of later years and again the new controls of the present war, and by subsidized houses and the rest. What is important are the findings of the authors from examination of the returns and other information. One of these findings is outstanding—that governments and the central committee have been aiming at a mistaken objective, an obligatory objective as the law stands but one considered inequitable and probably impracticable as things are. They find that, apart from other failings, the lower ranges of houses have been commonly assessed for rating at values below those required by the law, that this has

happened particularly since the much higher cost of providing houses and the big rises in rates in the years after the last war, and that it has been done chiefly from a general feeling that otherwise an unfair burden of rates would fall on the less monied classes of ratepayers, a justified feeling, in the view of the authors. They find also that there is a larger difference between the true, strictly legal, assessment and the actual in the case of new houses within these ranges than in the old, because the new are assessed much at the same level as similar old houses, although they should be at a higher because new and usually better, and this again has occurred because of the general feeling that it is the equitable course. This is putting the matter broadly, but that is the general effect. I avoid using the authors' term "poor" houses, in particular because it may give a wrong impression of the wide range of ratepayers covered, even, for example, among those occupying "council houses."

The authors' cure is broadly this—aim at uniformity in assessing gross values on the present legal basis: continue the present legal deductions for repairs, etc., in ascertaining rateable values: in the case of small houses, allow a further deduction, on grounds of equity, in arriving at the appropriate rateable value: in addition, in the case of new small houses, allow each local authority "to make rate rebates . . . up to a maximum of (say) 20 per cent. of the rate payment which would otherwise be fixed" (a rebate, be it noted, not a reduction in rateable value), the rebate to be for a limited period of not more than "(say) 20 or 30 years," on the analogy of housing subsidies.

These would be radical innovations, but the authors make a case for their consideration. They would doubtless agree, however, that much else would have to be examined for a wise decision besides the matters which they mention, including some broad matters of policy. Incidentally, what with housing subsidies at different rates at different times and with more to be settled, differential rents according to means and needs, various rent controls and the rest, the position is becoming complicated and could do with a thorough investigation. But first we must bend our energies towards meeting the grave shortage of accommodation which is already upon us.

The authors also propose central, instead of local, valuation for rating. This is an old proposal, and there is a strong case for it, even for those who, for the future of our democratic polity, strongly deplore the transfer of local functions to the central government except for overwhelming reasons. But the change, if made, should be to the present central valuation authority, not to a new body as proposed. There is really no virtue in our all too frequent practice of spreading parts of what should be one job between a number of different departments, and much of the advantage of a central valuation department is derived from the enormous wealth of information which it gathers about the values of property. If the change were effected, proper provision would have to be made for present staffs (they have done much through their special organization to improve administration), though this might not be so easy as the authors seem to think. They might usefully have considered the Scottish system more fully. They give some information about it, but do not mention the place of the assessor (valuer), with his largely independent position in making his assessments; it is a possible alternative worth considering, if need be.

One of the many interesting facts which are brought out is that, contrary to what many suppose, small houses are more likely to be highly assessed in poor areas than in well-to-do, because the needs are greater.

A footnote on p. 10 will give a nasty shock to those who preach that the salvation of local finance lies in local income taxes. Sweden and Denmark have been held up as examples, despite their very different conditions from our own. The footnote states that, after an experience of 20 years, a Swedish royal commission has recommended replacing local income taxes by grants-in-aid. In Denmark, the local tax had already broken down as between the two towns of size, Copenhagen and its neighbour Frederiksborg, and a special adjustment was made.

Valuation for local rating is a tough subject, and it has to be confessed that

the present volume makes rather tough reading. It would have been well if the road could have been made less arduous, difficult though that might be: an index would also have been useful. The subject is very important; it concerns a large number of interests; the volume is much the best study of the subject produced for a long time and it should be widely read and its findings and proposals thoroughly considered. And there is substance in the closing remarks of the authors, even though pitched rather high, that there is danger that the rating system "will get into such a tangle" that it may be "swept away altogether," and that, "if it is swept away, the prospects of independent local government are black indeed." That would be a calamity of the first order for our democracy.

The report of the departmental committee has now been issued: it was made in 1939. There is a minority report by one member, and some reservations to that of the majority. In brief, the majority find that, if all dwelling-houses were properly assessed according to the law—(1) There would be some increase of assessment in the case of many houses built before the last war, but not substantial increases, "except in a few areas where the general level of assessments is at present unusually low." (2) The assessments of post-1918 houses would be increased in most areas, rented as well as owner-occupier houses, but "the extent of the increase throughout the country as a whole cannot be estimated." (3) Council houses are much in the same position, "except that a preference for non-council houses may justify a somewhat lower rental value for council houses." (4) Some occupiers of houses would suffer undue hardship, "but such cases are individual and it is impossible to distinguish them by classes. They would be found mostly among the tenants or owner-occupiers of the smaller types" of post-1918 houses.

The principal recommendations of the majority are—(1) Where a new assessment, made strictly according to present law, exceeds the old by more than 15% and the increase is not due to structural alterations or improvements, the occupier or owner should be able to apply for a temporary reduction on the ground of undue hardship. (2) The application should be decided by the assessment committee, acting preferably through small panels. (3) If this proposal be rejected because it involves enquiry into the personal circumstances of applicants, the majority prefers, of a number of suggestions, the one under which the increase of assessment would be limited to specified sums, the maximum permissible increases varying with the level of the previous rateable value. The report gives the following in illustration, the first figures in each pair being the old rateable value and the second the maximum new—£10-£13: £15-£18: £20-£23: £25-£29: £30-£34: £35-£44: £40-£54. (4) The new rateable value should operate only during the currency of the new valuation list, or a change of occupancy if earlier, because it is not possible to forecast the position at the end of the next valuation quinquennium.

The author of the minority report, Lady Simon, wants a minor revolution in rating (perhaps not so minor in its possibilities), and proposes that, for small houses, gross values "should represent the rental appropriate to the general economic circumstances of the occupying class in the locality," a notional valuation not likely to commend itself to the experienced. If there is a case for relief, it were better given on the general lines proposed by the Hicks.

The conflict between the findings and proposals of the majority report and those of the book previously reviewed is not so sharp as may appear, because the former, by its terms of reference, is concerned with "undue hardship," the latter with the equities of rating. But there is wide divergence in general tenour. This is not the place to try to arbitrate the differences, even if that were possible here, but some suggestions may be put forward. There is a strong case for continuing with the fundamentals of the present rating system, supplemented by the inevitable increase in central grants. But improvements are

needed, not only in the valuation of small houses, though that bulks biggest, but also of other classes of property; and derating should be considered afresh, though the years immediately after the war are not likely to be exactly propitious. All this would take time and, in any event, any big proposals would have to line up in the long queue of post-war measures. And it looks as though the facts of the present position are even yet not adequately known. If, in the meantime, some early measure should be held desirable, a scheme on the lines of the makeshift alternative preferred by the majority might be adopted, for reasons of economy and of despatch as well as for avoiding personal inquisitions. And, incidentally, the real incidence of rates, even in a market of housing scarcity, might well be more deeply probed, especially bearing in mind the big profits in the sale of land and of houses and the high costs of building.

I. G. G.

STATISTICAL NOTES

1. BRITISH OFFICIAL STATISTICS

DURING the three months July to September 1944 there was a slight advance (0.6 per cent.) in general wholesale prices as reckoned by the Board of Trade index-number. Food prices fell about $\frac{1}{2}$ per cent. and prices of industrial materials advanced about 1.1 per cent. There was a decrease of about $7\frac{1}{2}$ per cent. in the price of English wheat, with a smaller reduction in that of malting barley. The most considerable advances were in the prices of coal, which averaged 11.0 per cent., and in the controlled prices of manufactured iron goods. Prices of potatoes increased in July owing to the introduction of the new season's crop, but prices afterwards receded.

Compared with those prevailing in August 1939, the month before the war, there was an advance in general wholesale prices by September 1944 of 70 per cent. Food prices had advanced $73\frac{1}{2}$ per cent., and prices of materials and manufacture 68 $\frac{1}{2}$ per cent. The groups showing the greatest advances were: basic materials (excluding fuel) 96.8 per cent., cereals 95.2 per cent., cotton 95.7 per cent., and coal 90.1 per cent. The smallest increase was in the group of non-ferrous metals 27.1 per cent., but both supplies and prices of these have been controlled during most of the war. The Board of Trade index-number of wholesale prices is given below for recent months.

(Averages for the year 1930 = 100.)

Date	Total Food	Total not Food	All Articles	Basic Materials (excluding Fuel)	Intermediate Products	Manufactured Articles	Building Materials
June 1944	157.6	170.3	166.1	186.1	176.3	158.1	153.4
July "	160.5	170.1	167.1	186.0	176.1	157.9	153.4
Aug. "	158.8	171.7	167.5	186.0	176.2	158.9	153.8
Sept. "	156.8	172.2	167.1	186.0	176.2	159.9	154.2
Sept. 1943	158.8	161.7	162.0	175.2	171.0	155.9	150.1
Aug. 1939	90.4	102.2	98.1	94.5	104.0	108.7	104.1
Percentage increase in Sept. 1944 over—							
Sept. 1943	1.3*	4.6	2.6	6.2	2.5	2.6	2.5
Aug. 1939	73.5	68.5	70.0	96.8	69.4	47.1	48.1

* Decrease.

The figures for certain other British index-numbers of wholesale prices are also given below, together with that prepared by the United States Bureau of Labor.

Date	Board of Trade (1930 = 100)	Economist (1927 = 100)	Statist (1566-77 = 100)	The Times (1912 = 100)	U.S. Bureau of Labor (1926 = 100)
June 1944	166.1	117.6	160.0	185.0	103.8
July „	167.1	117.5	161.9	185.2	103.9
Aug. „	167.5	117.6	161.5	184.2	—
Sept. „	167.1	117.9	160.1	184.4	—
Sept. 1943	162.9	114.3	154.6	177.2	102.9
Aug. 1939	98.1	70.3	90.4	111.5	74.8

There has been no general change during the third quarter of 1944 in the *cost of living* of working-class families as measured by the index-number prepared by the Ministry of Labour and National Service. The price of potatoes rose during July, but fell in August and September, and there was a substantial increase in the prices of coal, which took effect from August 1st. The increase amounted to 4s. per ton or from 2d. to 3d. per cwt. The net effect of these changes was to leave the index-number the same at the end of the quarter as at the beginning (201), representing an increase of nearly 30 per cent. in the cost of living since the beginning of the war. Retail prices of articles of food have risen 22 per cent., of clothing 66 per cent., of fuel 45 per cent. and of other items * of family consumption included in the index-number 63 per cent. The index-numbers at the under-mentioned dates are shown below.

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	Total
July 1st, 1944 ...	169	164	345	253	291	201
Aug. 1st, „ ...	170	164	345	263	291	202
Sept. 1st, „ ...	169	164	345	263	291	202
Oct. 1st, „ ...	168	164	345	263	291	201
Oct. 1st, 1943 ...	168	164	340-345	244	291	199
Sept. 1st, 1939 ...	138	162	205-210	180-185	180	155

It should be noted that “no allowance has been made for any economies or readjustments in consumption and expenditure since the outbreak of war,” and changes in kind of articles purchased owing to rationing may probably entail increased expenditure on articles not included in the index.

The Ministry of Agriculture has published figures showing for the United Kingdom and for England and Wales, *the area under crops*, the numbers of livestock, and the estimated production of the principal crops for each of the years 1939-1944. The figures are issued without comment, but the percentage change in 1944 as compared with 1939 is shown.

In England and Wales the area of arable land has increased from 8,935,000 acres in 1939 to 14,588,000 acres in 1944, that is, by 5,653,000 acres, or 63.3

* Soap, soda, ironmongery, brushes, pottery, tobacco, fares and newspapers.

per cent. This increase has been drawn broadly speaking from the area under permanent grass, which has diminished by 5,959,000 acres, or by 37·9 per cent. The difference in the total area under crops and grass is consequently very small, the net change in the war period being a loss of some 300,000 acres. This corresponds roughly with the normal pre-war decrease, due to the absorption of agricultural land for building and other purposes, and in view of military requirements it is rather surprising that it should be so small. The explanation probably is that in response to the demand for production some land not hitherto regarded as agricultural has been brought within the purview of these returns. The above-mentioned loss in the area under crops and grass is compensated for to some extent by an increase in "rough grazings," and on balance the net decrease in agricultural land between 1939 and 1944 is only 90,000 acres.

Of the individual crops, the areas devoted to wheat, barley, oats and other grain rose by 86 per cent., potatoes by 116 per cent., sugar beet by 24½ per cent., and fodder crops of all kinds by 56 per cent. Vegetables for human consumption and other horticultural crops (excluding fruit) increased by 63½ per cent.

The 1944 grain harvest is estimated to be somewhat below that of 1943, though higher than in the preceding years, and this was also the case with the fodder and hay crops. Potatoes gave almost the same result as in 1943. Of the livestock population, cattle increased in 1944 and were 6·5 per cent. more numerous than in 1939, but sheep (— 29·8) and pigs (— 58·3) showed a substantial falling off. Poultry also declined by 43·5 per cent.

Similar figures for Great Britain and Northern Ireland are included in *Statistics relating to the War Effort of the United Kingdom* (Cmd. 6564, price 1s.). In this publication it is pointed out that the dominant aim of agricultural production during the war has been to increase the domestic output of food, and so save shipping space. In the United Kingdom, unlike many other countries, there was very little scope for doing this by increasing the area of cultivated land, as almost all the cultivable land was already in agricultural use. The problem has, therefore, been to increase the output of food on the existing land of a country where production was already of an intensive character. This has been done in two ways—by increasing the actual physical yield of the land (largely by ploughing up grass land), and by increasing the proportion of crops available for direct human consumption.

To alleviate the shortage caused by the reduction in imports of animal feeding stuffs, including the by-products of imported materials (which before the war amounted to about 8½ million tons and in 1943 had fallen to less than 1¼ million tons), larger quantities of fodder crops have been grown at home, mainly to maintain the production of milk. The output of meat, poultry and eggs has, however, had to be curtailed considerably.

It is estimated that the net output of human food from British agriculture has increased by at least 70 per cent. in terms both of calories and of protein. The outcome of this agricultural production programme, coupled with the control of food distribution, was that by 1943 it had become possible to maintain our total food supplies at an adequate level, while at the same time reducing imports

of food by 50 per cent., thus releasing an equivalent amount of shipping for war purposes. This has been accomplished in spite of the loss of about 100,000 regular male workers, though this loss was offset by the Women's Land Army, the enrolled strength of which was over 80,000 in the middle of 1944.

The number of workpeople recorded as unemployed showed at October 16th, 1944, an increase of 17,873 as compared with the number recorded at July 17th (63,197). The number of men increased by 10,091, of boys under 18 by 1,390, of women by 4,714 and of girls by 1,678. The number (81,070) unemployed at October 16th included 56,974 applicants for unemployment benefit or allowances, and was exclusive of 18,019 men classified as unsuitable for ordinary industrial employment and 411 unsuitable for normal full-time employment. The increase, though proportionately large, is of small dimensions, and is probably due to some slackening on certain types of war work not now so urgent. The demand for labour generally is still very great. The following table gives the numbers on the unemployment registers of the Ministry of Labour and National Service at the under-mentioned dates.

Date	Wholly Unemployed	Temporarily Stopped	Persons normally in Casual Employment	Total	Males	Females
Jan. 17th, 1944 ...	76,674	1,417	946	79,037	51,294	27,743
Apl. 17th, " ...	73,092	653	945	74,690	51,471	23,219
July 17th, " ...	61,905	599	693	63,197	45,032	18,165
Oct. 16th, " ...	79,235	1,029	806	81,070	56,513	24,557
Oct. 18th, 1943 ...	72,253	732	951	73,936	49,809	24,127
Aug. 14th, 1939 ...	968,108	211,978	51,606	1,231,692	947,099	284,593

At each July from and including July 1940, and at each January from and including January 1942, the Ministry of Labour and National Service has instituted a census of average weekly earnings of wage-earners employed in manufacturing industries and the principal non-manufacturing industries of Great Britain and Northern Ireland, excluding coal-mining and railway service. The returns received cover about 54,500 establishments and over 6,000,000 wage-earners. In addition, at July 1943 and January 1944 particulars of the man-hours actually worked in the weeks of the census were obtained in respect of nearly all of the men, boys, women and girls whose earnings were returned. The returns cover all classes of manual wage-earners, including unskilled workers and general labourers, as well as operatives in skilled occupations, and payments for overtime, nightwork and earnings on piece-work and other methods of payment by results are included. The earnings or salaries of managers, commercial travellers, clerks, typists, shop assistants, office staffs and salaried persons generally are excluded. The results of the censuses are

published from time to time in the *Ministry of Labour Gazette*,* and the earnings of men, boys, women and girls are shown separately for 91 industries and 16 industrial groups at each of the seven dates, and the hours worked in similar detail for the two latter censuses.

The following table shows the average earnings in one week of January 1944 together with the percentage increase over October 1938 of the weekly earnings at each of the census dates.

Industry Group	Average weekly earnings in		Percentage increase over Oct. 1938 of average weekly earnings in							
			Jan. 1944	July 1940	July 1941	Jan. 1942	July 1942	Jan. 1943	July 1943	Jan. 1944
	s.	d.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Iron, stone, mining and quarrying ...	90	1	22.1	38.8	32.6	48.8	48.7	62	59	
Treatment of non-metallic mineral products ...	98	5	26.1	38.2	33.3	49.3	52.6	60	61	
Brick, pottery, glass ...	79	3	19.8	35.8	35.8	50.3	56.1	64	66	
Chemical, paint, oil, etc.	93	0	25.3	35.7	35.0	47.3	55.8	64	69	
Metal engineering and shipbuilding ...	111	2	42.3	49.2	55.9	66.8	72.6	81	86	
Textiles ...	64	11	29.5	37.7	43.0	56.6	62.3	70	72	
Leather, fur, etc. ...	76	8	16.8	31.4	37.6	46.7	53.5	59	64	
Clothing ...	56	0	12.9	27.9	29.5	46.2	50.0	56	60	
Food, drink, tobacco ...	74	8	15.4	29.4	29.6	40.8	46.6	55	59	
Woodworking ...	79	5	16.7	31.4	27.8	42.9	43.6	53	53	
Paper, printing, stationery, etc. ...	84	2	1.6	17.9	20.5	27.9	32.3	40	46	
Building, contracting, etc. ...	93	7	32.6	47.6	27.7	54.6	43.6	64	53	
Other manufacturing industries ...	87	5	31.0	40.6	47.3	60.2	68.8	81	88	
Transport, storage ...	98	8	20.6	25.6	28.8	37.4	38.3	45	51	
Public utility services ...	81	6	10.6	20.2	22.9	27.9	28.8	34	37	
Government industrial services ...	111	1	33.9	26.8	27.3	34.8	38.4	52	58	
All the above ...	95	7	29.9	42.4	46.0	59.9	65.1	76	79	

It will be seen that in January 1944 the weekly earnings were highest in the metal, engineering and shipbuilding group of industries, and within this group the average earnings for all workers are highest in the motor and aircraft industry (130s. 7d.) and shipbuilding (125s. 8d.). The men (skilled and unskilled together) in these two trades earned 166s. 1d. and 142s. 9d. respectively. In 19 out of the 20 trades embraced in this industrial group men's earnings for the week exceeded 120s.

The following table gives the general figures for the earnings of men, women, youths and girls separately for the eight dates, and the hours worked so far as these were collected on the returns.

* November and December 1940; March 1941; November and December 1941; June and December 1942; June 1943; February and August 1944.

Date	Men (21 years and over)	Youths and Boys	Women (18 years and over)	Girls	All Workers
Average weekly earnings					
Oct. 1938	s. d. 69 0	s. d. 26 1	s. d. 32 6	s. d. 18 6	s. d. 53 3
July 1940	89 0	35 1	38 11	22 4	69 2
" 1941	99 5	41 11	43 11	25 0	75 10
Jan. 1942	102 0	42 6	47 6	26 10	77 9
July "	111 5	46 2	54 2	30 3	85 2
Jan. 1943	113 9	45 1	58 6	32 1	87 11
July "	121 3	47 2	62 2	33 10	93 7
Jan. 1944	123 8	46 10	63 9	34 3	95 7
Percentage increase compared with Oct. 1938					
July 1940	Per cent. 29	Per cent. 35	Per cent. 20	Per cent. 21	Per cent. 30
" 1941	44	61	35	35	42
Jan. 1942	48	63	46	45	46
July "	61	77	67	64	60
Jan. 1943	65	73	80	73	65
July "	70	81	91	83	76
Jan. 1944	79	80	96	85	79

Average hours worked in last pay-week of October 1938, July 1943 and
January 1944.

Date of pay-week	Men (21 years and over)	Youths and boys	Women (18 years and over)	Girls	All Workers
Average weekly hours worked					
Oct. 1938	Hours 47.7	Hours 46.2	Hours 43.5	Hours 44.6	Hours 46.5
July 1943	52.9	48.0	45.9	45.1	50.0
Jan. 1944	52.0	47.1	45.2	44.6	49.2
Average hourly earnings					
July 1943	s. d. 2 3.5	s. d. 0 11.8	s. d. 1 4.3	s. d. 0 9.0	s. d. 1 10.5
Jan. 1944	2 4.5	0 11.9	1 4.9	0 9.2	1 11.3

The average percentage increase in hourly earnings in January 1944, compared with October 1938, was for men 58 per cent., youths and boys (under 21) 74 per cent., women and girls 81 per cent., and all workers together 63 per cent.

It is to be hoped that the Ministry will ultimately publish the combined results of these censuses with any further information obtained therein not yet made available.

2. OTHER STATISTICS

The statistics of *retail sales* prepared by the Bank of England in conjunction with various retail distributors' Associations and Co-operative Societies show that during the first eight months (February to September 1944) of the trade year there were increased sales of goods amounting to 7 per cent. as compared with the corresponding period of 1943. Sales of food and perishables increased 6.1 per cent., and those of other merchandise 8.3 per cent. Sales decreased 5.1 per cent. in Central and West End London, and only increased 3.0 per cent. in suburban London. In other districts in Great Britain the increases ranged from 7.5 to 9.2 per cent. Smaller sales in London were caused probably to a great extent by the increased enemy activity over the London area in the last four months of the period. The departments the sales in which showed the greatest increases were "men's and boys' wear" (29.1 per cent.) and women's wear (16.0 per cent.). In furnishing departments the amount of sales decreased 10.6 per cent.

CURRENT NOTES

THE Conference of the Allied Ministers of Education, of which the Rt. Hon. R. A. Butler is Chairman, has requested the Council to make the Fellows of the Society aware of the pressing need of libraries (national, university, public and other) in the allied countries which have suffered enemy occupation and devastation.

Under the auspices of the Conference of Allied Ministers of Education, a Committee has been set up to administer the organization and premises known as the INTER-ALLIED BOOK CENTRE, where books can be received and systematically arranged for ultimate allocation. Already more than a million books, ranging over the whole field of knowledge, have been set aside from book drives. The collection includes books of every kind; but the proportion of *modern* technical, scientific, commercial and legal works is low, and they are exactly the books needed for the replenishment of destroyed libraries.

It is obviously desirable that as many of these libraries as possible should have a rich collection of the works of English standard authors, and in particular of the recent technical and scientific literature, publication of which has been largely stimulated by war-time research. Books in foreign languages as well as in English are also wanted.

Many libraries, having lost their whole stock, will urgently need sets of the more important periodicals, particularly the back numbers of Journals and Transactions. The appeal is, therefore, for complete sets, where possible; but even the gift of odd issues may enable us to make up such sets.

The provision of this essential material must depend largely on the generosity of universities; of scientific, literary and other learned bodies; and of their individual members. It is certain that those who themselves owe much to books will desire to help colleagues, especially in their own fields, by giving books which they can now be assured will be properly handled and, under expert guidance, be sent to the libraries where they will be most useful.

If anyone, who is unable to give books or periodicals, desires to support the general scheme, any money contributed will be used entirely for the purchase of

books and periodicals urgently required; but so many books have been destroyed, or are in short supply, that the need is for books rather than money.

It is suggested that the best use of any work can be assured only if a free hand is left to the expert committee of allocation to decide the ultimate destination of all books received; but if a donor urgently desires to give to a particular country, or even a particular library, he is asked to communicate with the Director of the Book Centre.

For the sake of economy in transport and labour it would be a great convenience if donors will first send to the Director lists of the books available. Carriage will be refunded, if so desired, on all books presented.

Books and periodicals in good physical condition, in all fields of knowledge, should be sent to the INTER-ALLIED BOOK CENTRE, where they will be acknowledged and dealt with by Mr. B. M. Headicar, the Director, and a qualified staff.

The Association of Scientific Workers have also issued an appeal for the provision of scientific literature for liberated Europe, to which we are glad to call the attention of Fellows:—

“Scientists in liberated Europe need literature dealing with advances made in allied countries during the war. In particular French scientists need this material as quickly as possible. In Paris, there is gas and electricity for only one or two hours in the evenings, so that experimental work is hardly possible. To help these scientists, who have played an active part in the Resistance Movement, to use their time profitably until they can restart their laboratories, and as a gesture of friendship, we should like to send them copies of scientific journals published during the war. All material sent to France would be fully used. Literature would go to the Centre National de Recherche Scientifique in Paris, which is in touch with the whole body of French scientific workers. Single copies would be microfilmed, and films and abstracts distributed. Thus the greatest possible use would be made immediately of any periodicals that can be sent to them.

“We are therefore appealing to British scientists to give to their French colleagues copies of scientific journals, technical papers, reprints, etc., from January 1940 onwards. We know it is hard for scientists to part with complete sets of Journals they have collected over years, but in this country there are well-stocked libraries which can be consulted, and this is not the case in France and the other newly-liberated countries. We hope that there will be a generous response to this appeal. Sets of journals and single copies should be sent to: The Association of Scientific Workers, Hanover House, 73 High Holborn, London, W.C. 1.”

The appeal is signed by W. H. Beveridge, P. M. S. Blackett, E. Carter, J. G. Crowther, C. D. Darlington, R. A. Gregory.

We are informed that editorial responsibility for the *Federal Reserve Bulletin*, beginning with the issue for April 1944, has been turned over by the Board of Governors to a staff editorial committee. Under the new arrangement the responsibility of the Board for the contents of the *Bulletin*, other than official statements and rulings, will be only of a general nature arising from its sponsor-

ship of the publication. The Board will not be directly responsible for the material included and the views expressed in signed or unsigned articles.

It was stated that this policy is intended to promote freedom of thought and vigour of expression by the writers and to encourage publication of articles on a wide range of subjects. The *Bulletin* has been published continuously since May 1915. It has served primarily to keep member banks and the public informed of official actions by the Board; to provide currently, in comprehensive form, the statistical background of System policies; and to present in articles and reviews informative discussion of developments which give rise to questions of public policy in monetary, credit, fiscal and related economic fields.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

UNITED KINGDOM—

Annals of Eugenics—October 1944—Allowance of double reduction in the calculation of genotype frequencies with polysomic inheritance: *R. A. Fisher*. The estimation of map distances from recombination values: *D. D. Kosambi*. The analysis of a tsetse-fly population: *C. H. N. Jackson*.

The Banker—

October 1944—Britain's external problem: *T. Balogh*. Northern Ireland: a financial and economic survey. The increase in window-dressing: *Paul Bareau*.

November 1944—The Gold Standard bogey. Reconstruction forum: (IV) The coal industry: *Walter Hill*. Belgium's monetary purge.

December 1944—Boom everlasting in the Beveridge Utopia. The rehabilitation of the franc: *Paul Bareau*. Blocked sterling balances: *Paul Einzig*. Municipal borrowing: *E. A. Grant*.

The Banker's Magazine—

October 1944—What banks are for: an essay on net productivity: *Akanthos*.

December 1944—Towards liberation: Western Europe to-day.

Economica—

November 1944—The agreements of Bretton Woods: *Ernest H. Stern*. The origins of the Bank Charter Act, 1944: *J. K. Horsefield*. Some aspects of the Malaya rubber slump, 1929-1933: *P. T. Bauer*. The Ulster Linen Industry: *A. Beacham*.

Economic Journal—June-September 1944—The Government's employment policy: *Sir William Beveridge*. The 1944 White Paper on National Income and Expenditure: *W. Manning Dacey*. Industrialisation and agriculture in India: *S. Kesava Iyengar*. The German war economy, XII: *H. W. Singer*.

Eugenics Review—October 1944—White Paper on Social Insurance. The Order of Merit: the holders and their kindred: *B. S. Bramwell*.

Institute of Actuaries, Journal of the—June 1944—Vol. LXXII, No. 333. The valuation of the outstanding liability for payments during incapacity in respect of workmen's compensation in the mining industry: *Harold Boag*. Income tax in relation to Social Security: *A. T. Haines* and *R. J. Kirton*. The recent trend of mortality in England and Wales: *W. S. Hocking*.

UNITED STATES—

American Economic Review—September 1944—The national output at full employment in 1950: *E. E. Hagen* and *N. B. Kirkpatrick*. Teaching of economics in the Soviet Union (translated from Russian): *Pod Zname-nem Marxizma*. Palestine—A problem in economic evaluation: *A. E. Kahn*. The British White Paper on employment policy: *M. F. W. Joseph*. The incidence of a profits tax: *K. E. Boulding*. The War Labour Board—An experiment in wage stabilization: Comment: *Milton Derber*. Reply: *J. C. Record*.

American Philosophical Society, Proceedings of—September 1944—Symposium on wartime advances in medicine. The International Labor Organization lessons for twenty-five years: *H. B. Butler*.

American Statistical Association, Journal—September 1944—Post-War planning for British official statistics: *Richard O. Lang*. International programming of the distribution of resources: A symposium. Organiz-

ing statistical work on a functional basis: *Harvey E. Becknell*. The sample census of congested production areas: *Howard G. Brunsman*. Analysis of the data of a public health organization by the control chart method: *Walter Schilling*. Matters of misconception concerning the quality control chart: *Edward M. Schrock*. Industrial materials production, World Wars I and II: *G. H. Moore*. Interpreting the statistics of medical examinations of selectees: *E. A. Lew*. Application of the logistic function to bio-assay: *Joseph Berkson*. The relative efficiencies of groups of farms as sampling units: *Walter A. Hendricks*. Cost of living on farms and prices paid by farmers: *John D. Black* and *Althea MacDonald*. On the summation of progressions useful in time series analysis: *Joseph A. Pierce*.

Annals of the American Academy of Political and Social Science—November 1944—Adolescents in War-time: Whole number.

Annals of Mathematical Statistics—September 1944—The elementary gaussian processes: *J. L. Doob*. On cumulative sums of random variables: *Abraham Wald*. Some improvements in weighing and other experimental techniques: *Harold Hotelling*. On the analysis of a certain six-by-six four-group lattice design: *Boyd Harshbarger*. On the expected values of two statistics: *H. E. Robbins*. On relative errors in systems of linear equations: *A. T. Lonseth*. A reciprocity principle for the Neyman-Pearson theory of testing statistical hypotheses: *L. M. Court*.

Econometrica—Vol. 12, Supplement—July 1944—The probability approach in econometrics: *Trygve Haavelmo*.

Journal of Political Economy—September 1944—Growth of the American glass industry: *Warren C. Scoville*. Recent trends in the German command economy: *Heinz Paechter*. Recent events in negro union relationships: *Robert C. Weaver*.

Review of Economic Statistics—August 1944—National product, war and prewar: Some comments on Professor's study: *Milton Gilbert*, *Hans Staehle* and *W. S. Woytinsky*. Frickey on the decomposition of time series: *Arthur F. Burns*. The "simple" theory of business fluctuations: A tentative verification: *Gerhard Tintner*.

Social Research—September 1944—Great Britain's trade policy: *Richard Schüller*. The United States in the future world economy: *Fritz Sternberg*. The coming peace crisis: *Alvin Johnson*.

MEXICO—

Estadística—September 1944—The development of population predictions in Europe and the Americas: *Irene Taeuber*. Comentarios sobre Nuevas Aplicaciones de la Técnica de las Muestras: *Loreto Domínguez*. Sobre las estimaciones de la población: *Elbridge Sibley*.

INTERNATIONAL—

International Labour Review—

September 1944—Factory inspection in China: *T. K. Djang*. Swedish housing policy in wartime: *Alf Johannson*. Developments in welfare work for British seamen: *R. J. P. Mortished*. The effects of general mobilisation on the employment of women in Germany.

October 1944—Co-operative organisation and the restoration of European farm production. The agrarian situation in India: *Parekunnel J. Thomas*. The mobilization of Foreign Labour by Germany.

November 1944—Inter-Co-operative relations and post-war planning. The United States public work reserve: *Benjamin Higgins*. Housing problems in Great Britain: *Marian Bowley*.

REGISTRATION OF THE UNITED KINGDOM

No. I.—ENGLAND AND WALES

BIRTHS, DEATHS and MARRIAGES registered in the Calendar years 1939–43 and in the Quarters of those years. Numbers, Annual and Quarterly Rates† per 1,000 persons living. (Deaths under 1 year of age; rate per 1,000 Live Births; Stillbirths per 1,000 Births.)

Years	1939		1940 *		1941 *		1942 *		1943 *	
Estimated Mid-Year Popln. in thousands	11,100 ¹									
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	619,352	14.9	607,029	14.6	587,228	14.2	654,029	15.8	683,213	16.5
Stillbirths ...	24,309	3.8	22,731	3.6	20,902	3.4	22,335	3.3	21,275	3.0
Deaths ² ...	199,902 ²	12.1	581,537 ⁴	14.0	555,140	12.9	480,137	11.6	501,464	12.1
Marriages ...	439,691	10.6	470,519	11.4	388,921	9.4	369,741	8.9	285,414	7.2
Infant Mortality ...	31,190	5.0	33,892	5.6	34,530	5.9	32,280	4.9	33,132	4.9
Quarters										
Live Births in the Quarters of each Calendar Year										
Jan.-Mar. ...	153,382	15.0	154,345	14.9	147,027	14.2	158,225	15.3	172,271	16.6
Apr.-June ...	161,306	15.9	166,886	16.1	147,414	14.2	167,611	16.2	150,709	14.4
July-Sept. ...	161,023	15.4	149,092	14.4	147,621	14.2	168,335	16.2	169,307	16.3
Oct.-Dec. ...	140,611	13.5	136,906	12.3	115,166	14.0	159,306	15.4	160,926	15.5
Stillbirths										
Jan.-Mar. ...	6,293	4.0	6,223	3.9	5,632	3.7	5,652	3.4	5,783	3.2
Apr.-June ...	6,362	3.7	5,994	3.5	5,407	3.5	5,757	3.3	5,377	3.0
July-Sept. ...	6,946	3.0	5,371	3.5	4,970	3.5	5,437	3.1	4,940	2.9
Oct.-Dec. ...	5,706	3.9	5,143	3.6	4,893	3.3	5,450	3.3	4,935	3.0
Deaths ² (excluding Stillbirths)										
Jan.-Mar. ...	154,285	15.1	205,163	19.8	178,637	17.2	151,263	14.6	137,588	13.3
Apr.-June ...	120,574	11.7	119,706	11.5	140,186	13.5	116,937	11.3	112,907	10.9
July-Sept. ...	113,300	9.9	111,733	10.8	101,336	9.8	97,335	9.4	98,500	9.5
Oct.-Dec. ...	121,743	11.8	144,915	14.0	115,021	11.1	114,603	11.1	152,469	14.7
Marriages										
Jan.-Mar. ...	47,191	4.6	109,322	10.5	81,031	7.8	88,280	8.5	62,337	6.0
Apr.-June ...	102,816	9.9	116,700	11.3	105,576	10.2	100,092	9.7	82,120	7.9
July-Sept. ...	132,030	14.6	131,891	12.7	101,702	10.1	96,445	9.3	81,464	7.9
Oct.-Dec. ...	136,827	13.2	112,083	10.9	97,608	9.4	84,027	8.1	69,503	6.7
Infant Mortality ³										
Jan.-Mar. ...	9,078	6.5	11,876	7.7	10,085	7.5	9,697	6.1	9,914	5.8
Apr.-June ...	7,898	4.8	7,681	4.6	6,712	5.9	7,820	4.7	8,028	4.4
July-Sept. ...	6,368	3.9	6,316	4.2	6,411	4.3	6,766	4.0	6,771	4.0
Oct.-Dec. ...	6,763	4.8	7,765	5.7	8,184	5.0	7,713	4.8	8,370	5.2

* Provisional.

† All rates are based upon the estimated mid-year population of 1939 and, except for 1939, are provisional.

¹ The normal mid-1939 estimate of population (i.e., appropriate for the calculation of birth or marriage rates) is 41,460,000. For use with the deaths of non-civilians only the figure would be 41,246,000.

² Including deaths of non-civilians registered in England and Wales.

³ Includes 836 deaths of non-civilians registered in England and Wales 3 September–31 December, 1939; and 98 deaths registered in the Gresford Colliery disaster in 1934.

⁴ Includes 8,893 deaths of non-civilians registered in England and Wales.

⁵ The numbers of deaths under 1 year of age are extracted from the R.G.'s quarterly returns. These are the provisional figures and in the aggregate differ slightly from the corrected figures for the complete calendar year.

No. II.—SCOTLAND

BIRTHS, DEATHS and MARRIAGES registered in the Calendar years 1939-43 and in the Quarters of those years. Numbers, Annual and Quarterly Rates † per 1000 persons living. (Deaths under 1 year of age; rate per 1,000 Live Births; Stillbirths per 1,000 Births.)

Years	1939		1940 *		1941 *		1942 *		1943 *	
Estimated Mid-Year Popln. in thousands	5,007									
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	86,899	17.4	86,403	17.3	88,713	17.9	90,697	18.1	91,083	18.9
Stillbirths ...	3,832	.42	3,799	.42	3,686	.40	3,602	.38	3,191	.36
Deaths † ...	64,113	12.9	72,775	14.5	73,568	14.5	61,993	13.0	66,733	13.3
Marriages ...	46,336	9.2	53,322	10.7	47,620	9.5	47,314	9.5	38,271	7.6
Infant Mortality ...	5,935	.69	6,766	.78	7,426	.83	6,283	.69	6,171	.65
Live Births in the Quarters of each Calendar Year										
Quarters										
Jan.-Mar. ...	21,420	17.4	22,113	17.7	22,254	17.8	21,885	17.5	23,277	18.6
Apr.-June ...	23,615	18.9	23,298	18.6	23,433	18.7	21,142	19.3	25,489	20.3
July-Sept. ...	21,519	17.1	21,154	16.9	22,666	18.1	22,686	18.0	23,320	18.6
Oct.-Dec. ...	20,366	16.1	19,838	15.8	21,410	17.1	22,084	17.6	22,046	18.1
Stillbirths										
Jan.-Mar. ...	958	.43	1,016	.44	1,039	.45	970	.42	940	.39
Apr.-June ...	970	.40	980	.40	961	.39	931	.37	888	.34
July-Sept. ...	989	.44	915	.41	869	.37	835	.36	825	.34
Oct.-Dec. ...	908	.43	905	.44	829	.37	836	.38	813	.36
Deaths † (excluding Stillbirths)										
Jan.-Mar. ...	19,995	15.4	25,036	20.7	23,332	18.6	19,411	15.5	17,746	14.2
Apr.-June ...	15,672	12.6	16,002	12.8	18,099	15.2	16,298	13.0	15,674	12.7
July-Sept. ...	13,587	10.8	14,209	11.4	14,481	11.6	13,783	11.0	14,243	11.4
Oct.-Dec. ...	16,139	12.8	16,628	13.3	15,763	12.6	15,438	12.3	18,870	15.1
Marriages										
Jan.-Mar. ...	7,659	6.2	11,988	9.6	10,732	8.6	12,740	10.2	9,290	7.4
Apr.-June ...	9,935	8.0	12,953	10.3	12,358	9.9	12,238	9.8	9,721	7.8
July-Sept. ...	13,613	12.4	15,604	12.5	13,052	10.4	11,016	9.5	10,228	8.2
Oct.-Dec. ...	13,009	10.3	12,977	10.4	11,478	9.2	10,020	8.5	9,032	7.2
Infant Mortality										
Jan.-Mar. ...	1,890	.88	2,174	1.12	2,435	1.09	1,960	.90	1,754	.75
Apr.-June ...	1,442	.61	1,508	.67	1,965	.84	1,511	.64	1,179	.58
July-Sept. ...	1,220	.57	1,215	.57	1,121	.61	1,322	.59	1,283	.55
Oct.-Dec. ...	1,403	.69	1,509	.76	1,012	.75	1,467	.66	1,666	.71

* Provisional figures.

† Based on estimated population mid-1939 (except the quarterly rates for the year 1939, which are as published in the R.G.'s returns, and are based on quarterly estimates of the population).

‡ Including non-civilian deaths registered in Scotland.

No. III.—NORTHERN IRELAND

BIRTHS, DEATHS and MARRIAGES registered in the Calendar years 1939–43 and in the Quarters of those years. Numbers, Annual and Quarterly rates † per 1,000 persons living. (Deaths under 1 year of age; rate per 1,000 Live Births.)

	1939		1940		1941		1942 *		1943 *	
Estimated Mid-Year † Popln. in thousands	1,295		1,296		1,288		1,298		1,303	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births	25,240	19.5	23,368	19.6	26,857 †	20.9	20,615	22.8	21,538 †	24.2
Stillbirths ‡					Not registered					
Deaths †	17,542	13.5	18,911	14.6	19,640 †	15.2	17,256	13.3	17,438	13.4
Marriages	9,185	7.1	9,795	7.6	11,966 †	9.3	11,673	9.0	10,141	7.8
Infant Mortality ...	1,779	7.0	2,179	8.6	2,059	7.7	2,265	7.6	2,458	7.8
Quarters	Live Births in the Quarters of each Calendar Year.									
Jan.–Mar.	6,230	19.3	6,159	19.9	6,206	19.3	6,781	20.7	7,011	24.3
Apr.–June	6,858	22.2	7,077	21.8	7,232	22.5	7,990	24.6	8,693	26.7
July–Sept.	6,339	19.6	6,830	19.5	7,107	22.0	7,835	24.2	7,730	23.8
Oct.–Dec.	5,815	18.0	5,497	17.0	6,381	19.8	7,097	21.9	7,183	22.0
	Deaths † (excluding Stillbirths)									
Jan.–Mar.	5,317	16.6	6,597	20.4	6,183	19.2	5,168	15.9	4,891	15.0
Apr.–June	4,371	13.5	4,504	14.2	5,763	17.9	4,247	13.2	4,385	13.3
July–Sept.	3,683	11.4	3,759	11.6	3,711	11.6	3,639	11.2	3,612	11.2
Oct.–Dec.	4,141	12.8	3,991	12.3	3,085	12.4	4,162	12.8	4,570	14.0
	Marriages									
Jan.–Mar.	1,435	4.4	2,131	6.6	2,099	6.5	2,460	7.6	2,330	7.2
Apr.–June	2,191	6.8	1,994	6.2	3,033	9.4	3,211	9.9	2,647	8.1
July–Sept.	2,499	9.0	3,027	9.3	3,837	11.9	3,106	10.5	2,891	8.9
Oct.–Dec.	2,660	8.2	2,643	8.2	2,959	9.2	2,627	8.1	2,291	7.0
	Infant Mortality									
Jan.–Mar.	599	9.6	659	10.7	543	9.1	652	9.7	676	8.5
Apr.–June	418	6.5	601	8.5	518	7.2	569	7.1	647	7.4
July–Sept.	316	5.5	481	7.0	467	6.6	511	6.5	589	7.6
Oct.–Dec.	384	6.6	403	7.3	509	8.0	527	7.4	516	7.6

* Provisional figures.

† All rates are based on the estimated population of the calendar year.

‡ The annual figures have been corrected, so that slight differences appear between them and the aggregates of the quarterly figures.

§ Excluding, after 1939, persons serving as members of the Navy, Army and Air Force.

¶ Stillbirths are not registered in Northern Ireland. The birth of one living child and one stillborn, or one living child and two stillborn, is counted as a single birth.

No. IV.—EIRE

BIRTHS, DEATHS and MARRIAGES registered in the Calendar years 1939–43 and in the Quarters of those years. Numbers. Annual and Quarterly rates † per 1,000 persons living. (Deaths under 1 year of age; rate per 1,000 Live Births.)

Year	1939		1940		1941		1942		1943 †	
Estimated Mid-Year Popln. in thousands	2,934		2,958		2,993		2,963		2,951	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Live Births ...	56,070	19.1	56,594	19.1	56,780	19.0	66,117	22.3	65,702	22.3
Stillbirths * ...					Not registered					
Deaths ...	41,717	14.2	41,885	14.2	43,787	14.6	41,610	14.1	43,486	14.7
Marriages ...	16,204	5.2	15,212	5.1	15,021	5.0	17,470	5.9	17,350	5.9
Infant Mortality ...	3,691	66	3,769	66	4,176	74	4,591	69	5,245	80
Quarters										
Live Births in the Quarters of each Calendar Year										
Jan.–Mar. ...	14,245	19.4	14,084	19.0	13,673	18.3	14,427	19.5	16,679	22.7
Apr.–June ...	14,475	19.7	15,134	20.5	14,955	20.0	18,181	24.5	17,318	23.4
July–Sept. ...	14,302	19.4	14,385	19.5	15,067	20.2	17,749	24.0	16,538	22.4
Oct.–Dec. ...	13,088	17.8	12,991	17.6	13,085	17.5	13,780	21.3	15,237	20.7
Death (excluding Stillbirths)										
Jan.–Mar. ...	13,313	18.1	13,361	18.1	14,053	19.6	12,122	16.4	12,003	17.1
Apr.–June ...	10,373	14.1	10,481	14.2	11,313	15.1	10,822	14.6	10,911	14.8
July–Sept. ...	8,600	11.7	8,442	11.4	8,679	11.6	8,497	11.5	8,971	12.2
Oct.–Dec. ...	9,482	12.9	9,601	13.0	9,153	12.2	10,199	13.6	10,908	14.8
Marriages										
Jan.–Mar. ...	3,487	4.8	3,503	4.7	3,520	4.7	4,013	5.4	4,519	6.2
Apr.–June ...	3,665	5.0	3,808	5.1	3,643	4.9	4,803	6.2	3,970	5.4
July–Sept. ...	4,514	6.2	4,592	6.2	4,202	5.6	5,021	6.8	5,100	7.0
Oct.–Dec. ...	3,638	4.8	3,309	4.5	3,656	4.9	3,833	5.2	3,671	5.0
Infant Mortality										
Jan.–Mar. ...	1,173	82	1,103	78	1,151	84	1,163	81	1,561	94
Apr.–June ...	932	64	951	63	1,080	72	1,110	63	1,286	75
July–Sept. ...	764	53	783	51	976	65	1,031	58	1,160	71
Oct.–Dec. ...	832	64	967	75	968	74	1,214	79	1,229	81

* Stillbirths are not registered in Eire. The birth of one living child and one stillborn, or one living child and two stillborn, is counted as a single birth.

† Provisional figures.

‡ Based on the mid-year estimates of the population for the calendar year.

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NOTICE

THE Council of the Royal Statistical Society wish it to be understood that the Society is not responsible for the statements or opinions expressed in the Papers read before the Society or published in its *Journal*.

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NOTICE

The present issue of the Journal combines Parts III and IV of Volume CVII, 1944. The Parts of Volume CVIII, 1945, will be issued in a similar form or, possibly, as one single volume. The Council has authorised the Honorary Editors to adopt this temporary procedure in order to enable the publication of the Journal to be brought up to date as speedily as possible. The contents of the combined parts are substantially the same as would have been included in two single parts.

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JOURNAL OF THE ROYAL STATISTICAL SOCIETY

PARTS III-IV, 1944.

THE WARTIME SOCIAL SURVEY

By KATHLEEN BOX and GEOFFREY THOMAS

[Read before the ROYAL STATISTICAL SOCIETY, May 16th, 1944, the PRESIDENT,
DR. E. C. SNOW, C.B.E., in the Chair.]

THE Wartime Social Survey is the Government social research unit and has been set up to provide any department with information needed for the formation and administration of policy, which is not available from other sources. It is concerned with social problems, in the investigation of which it aims at establishing facts and the attitudes of the public towards these facts.

The method used to achieve these ends may be described briefly as interviewing samples of the general public, or of particular sections of the general public, with a recording schedule devised so that the results of the inquiries made can be expressed statistically.

Investigations are carried out by fifty-five trained fieldworkers, all women. These are divided into two teams, mobile investigators who travel about the country, and regional investigators who live in the areas in which they work. The latter are distributed throughout the country in such a way that the main centres of population, and a selection of small towns and rural areas, can be covered by them.

The advantages of having fieldworkers divided into these teams is twofold. On the one hand the mobile team can reach any part of the country in which it is desired to make inquiries, or can be concentrated in any one area. The regional investigators, on the other hand, are able to collect special knowledge of the areas in which they work and to keep in touch with officials of Government Departments, who can often give valuable information about the locality.

The technical, administrative and clerical staff of the Survey numbers thirty-five. The annual budget of the Survey is about £40,000, and in the last year the Survey has carried out thirty-six surveys of varying length.

At this point it may be worth while to give a short account of how the Survey's inquiries are received by the public. In view of the Society's recent *Memorandum on Official Statistics*, which deals among other subjects with the change in the public's attitude towards statistics observed in the last few years, this is particularly relevant at the moment.

The Wartime Social Survey has found members of the public willing, and even enthusiastic, to give information about their habits and opinions in connection with many different subjects. This is particularly encouraging when it is remembered that most people have now many more demands on their time and energy than in peace-time, and they may be required to give up periods ranging from ten minutes to an hour or more to answering investigators' questions.

When visiting informants at their homes, fieldworkers are frequently offered hospitality, and managements are in general very helpful in allowing investigators

facilities to interview their staff, the workers showing equal willingness to be interviewed, although in some cases, when they are working on piece-rates, this does mean some sacrifice.

The reception that fieldworkers are accorded suggests that the public is ready to appreciate the importance of such inquiries and to give all possible help. An explanation of the purpose of the inquiry is, of course, always given at the beginning of the interview. The proportion of people eventually refusing to be interviewed is about 0.5 per cent. in most inquiries. Fieldworkers are instructed to assure informants that giving information is entirely voluntary and that there is no need for them to answer if they do not wish to.

Since its reorganisation in August 1941 the Survey has been asked to investigate a wide variety of problems. Some examples are:

For the Ministry of Food

Cooking Habits. Meals eaten by people doing different sorts of work. Public attitudes towards food rationing and food shortages. Public attitudes towards Ministry of Food publicity.

For the Board of Trade

Clothing needs in selected occupation groups. Shortage of various household commodities. Clothes rationing.

For the Ministry of Health

Response of parents to the campaign for Diphtheria Immunisation. Public attitudes towards Ministry of Health education campaigns—e.g., the "Coughs and Sneezes" posters, Venereal Diseases campaign. Preliminary work for a national morbidity index. Nutrition of school-children.

For the Ministry of Information

Public attitudes towards various publications. M.O.I. Films, Books, etc., and towards publicity campaigns carried out by the M.O.I. for other Government Departments.

For the Department of Scientific and Industrial Research

Domestic Heating and Lighting problems, and Sound in Dwellings.

For the Department of Health for Scotland

Scottish Housing and the location of dwellings in Scotland.

For the Ministry of Agriculture

Farmers' attitudes to Ministry of Agriculture educational publicity. Response to the "Dig for Victory" campaign amongst owners of gardens and allotment holders.

So far as the methods used for tackling such problems are concerned, the Survey has had to rely very largely on devising its own techniques suitable for different occasions as they arose. The experience gained by other workers in the field of social research, both in this country and in America, has been used, and most members of the research staff, coming as they do from different organizations which have been doing allied work for many years, have had different contributions to make. However, social research of the type done by the Survey is still a very young science, and there are very few rules which can be laid down as applicable on all occasions. Moreover, as has been shown, the problems with which the Wartime Social Survey has been asked to deal are very varied, and new inquiries frequently demand the working out of some new device.

A further point which should be made is that the Survey differs from some other organizations which have been concerned with conducting social surveys in that the results of its work are generally needed urgently, and thus the amount of time that can be spent on any one inquiry is limited.

The work may be divided broadly into three sections: (1) finding a representative sample; (2) the framing of questions and drawing up of recording schedules; and (3) the analysis and interpretation of results. Each of these will be discussed in detail.

Sampling Methods

It will be seen from the examples of inquiries carried out that the Wartime Social Survey has needed to take samples of a wide variety of populations. The main problem is to find methods which, while satisfying the demands of sampling theory, are at the same time workable and practical. In general the stratified method of sampling has been used with random selection of units within the strata. However, different inquiries being concerned with different populations, the details of the sampling methods used of necessity vary very much from one inquiry to another. These must depend on several factors: the nature of the population, its homogeneity or otherwise, the amount of information existing in official and other statistics about the population, and the times and places at which members of the population are most readily accessible.

The types of population sampled in W.S.S. inquiries may be classified roughly into three groups. In many inquiries information is required about the whole adult civilian population of Great Britain. For example, reactions to publicity, food, health and other problems often concern the whole population, and information as to the habits and opinions of the general public is wanted.

A rather larger group of problems concern only housewives, and there are many others which relate to households, about which the housewife is the person best suited to give information. Domestic lighting and heating are examples of this type.

A third type of problem relates to particular groups. Examples are the inquiry carried out for the Ministry of Agriculture, which concerned only farmers and farmers' wives, and an inquiry made for the Board of Trade regarding injury to working clothes, which applied only to workers whose clothes were subject to hazards from acids, oils and grease, and heat. Less frequently, as in the Scottish Housing survey, a particular geographical area has been the subject of inquiry. Other inquiries, for instance "Getting to work," a survey made for the Ministry of War Transport, have been concerned specifically with the wage-earning population.

It will be seen that in all cases the populations about which information is required are large, and that the degree of homogeneity varies considerably. The methods of sampling used must thus be adapted to the population under study.

In general, the first stratification made is by region, and for this purpose the twelve Civil Defence regions are used. These practically coincide with the Ministry of Food regions, and the quotas required from each are based on the Ministry of Food's population figures. In each region a number of towns, and rural areas, of representative size and type are selected, and the appropriate number of interviews is made in each.

Further stratification must depend on the nature of the population and also to some extent on the subject of inquiry. With regard to the latter a general

principle is adopted of controlling the sample, so far as is possible, in respect of those factors which have a direct and obvious bearing on the problem. For instance, in surveys concerned with housing, where a representative sample of all types of dwelling is required, fieldworkers have been instructed to obtain information from the local rating or other authorities as to the proportion of houses and of flats or tenements in the districts in which they are working. Apart from such special controls, for which information as to the proportions in different groups can often only be obtained on the spot by the fieldworkers, certain general controls are used regularly in samples of different sorts.

In inquiries relating to the whole adult civilian population, the population is stratified by sex and by occupation, as well as by region and by urban and rural areas. Stratification by sex presents no difficulty, but the division of the population into occupation groups and allotting the appropriate number of interviews to each group is a matter of some concern. The lack of any up-to-date information on the proportions of the population following different occupations is a serious drawback to the Survey. Also such classifications as have been made at different times are not altogether satisfactory for social survey purposes.

Up-to-date Ministry of Labour statistics showing the distribution of the insured population by industry group, by region, are available to the Survey, and these provide the basis for the occupation classifications used. However, it is necessary to make estimates of the number of workers doing different sorts of jobs (*e.g.*, clerical, supervisory, operative) within the different industry groups, and also of the number of workers in different groups who are not insured. For making these estimates any available information is used—*e.g.*, less up-to-date information, such as the last Census of Production and the Population Census.

The difficulties are not so great as it might appear, because the type of classification best suited to the Survey's work is very simple and the groups very broad. The classification most frequently used in surveys relating to the general public is given below. These groups may be expanded or merged to meet the needs of individual surveys.

(1) Factory workers (operatives) in:

- (a) Heavy industries.
- (b) Light engineering and light munitions work.
- (c) Other light industries (food, drink, tobacco, textiles, clothing, paper, wood, pottery, etc.)

(2) Agricultural workers.

(3) Transport workers (and public utilities).

(4) Building workers and road menders.

(5) Miners.

(6) Distributive workers (shop-assistants and roundsmen and women).

(7) Clerical workers.

(8) Miscellaneous (*e.g.*, domestic service, catering, A.R.P.).

(9) Managers, directors and employers.

(10) Professional workers.

(11) Housewives (different income groups being distinguished).

(12) Retired and unoccupied.

Excluding managers and employers.

The divisions take into account both type of work and status, and very often results show sharp differences in habits or opinions between the different groups.

Fieldworkers are provided with a quota sheet showing the numbers of male and female informants to be selected in each group and a detailed definition of each group with examples of the types of occupation to be included.

Age-group, size of family and marital status are infrequently used as controls, but information about them is obtained and used as a check on the sample.

The problem of selecting individuals within the defined groups must depend very largely on circumstances. Workers are generally interviewed at their place of work. Lists of workplaces in different areas are being compiled during the course of inquiries, and care is taken that not more than a maximum number of workers is selected from any one workplace, and that the factories, etc., are selected in representative proportions in respect of the number of employees and of other characteristics.

Before beginning to interview at any place of work, the fieldworker has to ask the permission of the management and secure their co-operation. Managers are often extremely helpful, providing interviewers with lists of employees from which they may select names at random. Frequently, however, such lists are not available and some other method of selection has to be adopted, such as walking through the workshops and selecting operatives at regular intervals. It is thus not possible to lay down any fixed rule for investigators to follow, although the use of a list is recommended whenever possible. The Survey relies on educating the fieldworker to understand the need of avoiding bias in selection, so that she may adapt herself to different situations and devise suitable methods.

Housewives are interviewed at their homes, and here the problem of selection is less difficult. Different methods have been tried, and each has its own advantages and disadvantages. On some occasions ration cards have been used and addresses selected from these at regular intervals. The fieldworker then visits the chosen addresses, and calls back two or three times if the housewife is not at home. This method has the advantage of ensuring that the selection of individuals is random, and that the sample is well scattered. A disadvantage is that it is not always possible to make contact with the chosen housewife even if several calls are made. In this case substitutes have to be taken, generally the housewife living next door. A note is made when a substitute is interviewed instead of the original housewife. Another disadvantage is that it is uneconomical in the time taken to complete the quota, while the results of inquiries are often needed urgently. A third disadvantage, a very considerable one in winter, is that the fieldworker has to walk long distances to find the addresses selected, which is time-consuming, and the effect of finding the housewife out is discouraging, so that less energy is left for the actual interview.

Where samples of housewives have not been selected in this way the sample has been further stratified by income group. Here again great difficulty lies in the fact that there are no up-to-date statistics of family incomes. At first the Survey made use of the classification commonly used by market research workers, which divides the population into four main groups. These are designed to correspond roughly with four "social classes," and many different criteria are used to determine in which group a family is placed. Examples are type of house, occupation of chief wage-earner, whether or not the family possesses a car, keeps a servant or is on the telephone, and at what sort of school the children, if any, are educated. This method of classification is open to several criticisms.

In the first place, the income levels given as typical of the four groups no longer have any meaning in view of recent economic changes, and the criteria used to assess income group are equally out of date, particularly in wartime conditions. Apart from these objections, if the family income is not ascertained by the interviewer, and the questions needed to find this out are enough to constitute an inquiry in itself, the group in which a family is placed must depend very largely on the investigator's subjective judgment of "social class."

As an alternative the Survey has devised a classification dependent on the wage-rate of the principal wage-earner, and has laid down that the fieldworker should establish three things before classifying a household: who is the chief wage-earner, what is his or her occupation, and what is the wage-rate. In practice it is not always possible to obtain the last of these, but often the occupation is sufficient guide.

According to this classification families are placed in one of five groups, which may be described briefly as follows: (1) The social pensioner and soldier's wife, (2) The unskilled labourer, (3) The semi-skilled and skilled worker, (4) The higher clerical and lower administrative and professional workers, and (5) The remainder of the population having higher salaries or incomes. This classification, although rough and ready, has at least the advantage of being independent of interviewer-bias.

The proportions to be included in each group must still depend on not very satisfactory estimates, but material is gradually being collected by the W.S.S., through its random samples of households, which will provide this information for use in future work.

Where income group is used to control the sample, information is sought from the police, or other officials with local knowledge, as to the districts in which families belonging to different income groups are most frequently to be found. In towns where there are regional investigators this information has already been collected and areas marked off on street maps. The investigator then goes to the different types of district and selects streets where she expects to find families in the different groups. The houses to be visited in these streets are selected according to some previously determined plan—*e.g.*, every tenth house or from lists of random numbers. If the household does not belong to the expected income group, it is classified in the group to which it does belong, and further calls are made in other streets until the required quota of each group is completed.

Calling back is not always insisted upon, and this and the rigidity or otherwise of the rules to be used in selecting households may vary from one inquiry to another. In some cases the effect of missing housewives who are out may be more serious than in others. For instance, calling back is more important if the inquiry is concerned with food queues, as "chronic queuers" are perhaps more likely to be out than are other housewives, and it is essential that the correct proportion of these should be included. In other types of inquiry the result of interviewing only those housewives who are found at home on the first visit may be less serious or negligible. Some checks that have been used suggest that it is not always important.

The problem of whether or not housewives who are also wage-earners are to be included, of course, has to be decided before the sample is worked out. Such housewives, being very frequently out, are generally interviewed at their place of work. Information as to the number of working housewives in different geo-

graphical areas and in different occupations would be invaluable here, but such information as exists includes only a limited number of age-groups and of occupations. The Survey is collecting information, however, during the course of its inquiries. Until statistics have been compiled there is no choice but to rely on general knowledge of different localities.

For populations of special groups, such as workers in acids, oils, and heat, it is more difficult to find any general rules. In this particular case very little was known of the distribution of the population, and general, inexact knowledge had to be used in working out the sample, and in deciding where such workers were to be found. Another example of a population even more nebulous was that sampled in an inquiry in connection with the recruitment of nurses and midwives, which was carried out for Campaigns Division of the Ministry of Information. In this survey it was required to take a sample of potential recruits to nursing. In fact, women may be released from almost any occupation if they wish to nurse. The age limits of women eligible for the job are not defined, although only a few would be accepted from the older age groups. There was an objection to including married women in the sample, as these were unlikely to take up nursing as a permanent career, although there is no rule against their entering the profession. It was decided to limit the population to single women and to place an arbitrary limit on the age groups to be included. Women in most, but not in all occupations, were to be included. Thus the problem was to take a sample of single working women between certain ages, and no exact information was available showing the distribution of such women by occupation group, or even by industry group. The sample was tackled by selecting informants approximately in the proportions in which the whole female working population is distributed in these groups, with certain exceptions that seemed necessary.

On the other hand, the sample of farmers presented no difficulty, because good lists were available from which a random selection could be made. From the Ministry of Agriculture's Type of Farming Map of England and Wales certain areas representative of all types of farming were chosen in consultation with the Ministry. Maps of these areas were obtained and the parishes within them numbered in sequence. Four hundred parishes were then selected at regular intervals. The Ministry of Agriculture's tabulations of holdings by parish were consulted and holdings selected at regular intervals. The addresses of the holdings were found from the Ministry's addressograph, by looking up the appropriate code numbers.

Apart from such problems as these, there are other practical difficulties to be contended with in attempting to bring practice into line with theory. One of the greatest of these, particularly during the winter months, is illness. This is perhaps a more serious consideration in social surveys than in some other spheres. The fieldworker is required to stand up to all sorts of weather, and her job demands a high degree of energy and vitality.

It has already been said that the difficulty that might be anticipated in persuading individuals and managements to co-operate is slight; however, the investigator must select her times carefully to cause the minimum of inconvenience to those engaged on essential war work.

It will be seen from some of the examples that have been given that the ideal sample for the main part remains an ideal. It is only by trying out different methods that the practical difficulties can be partially overcome. The absence of

up-to-date official statistics on a number of subjects is, perhaps, the most serious and frequent drawback. In this respect, however, the Survey itself can perhaps be of great value. It has already been said that by means of random samples the Survey is gradually accumulating data on income groups, and other types of material is being collected in similar ways. The process is necessarily gradual, as this has to be done during the course of inquiries on other subjects, and the different sorts of samples taken vary in suitability for collecting such data. However, where there is an absence of statistical data, even on such elementary matters as the composition of the family, family income, and occupation, even such rough-and-ready classifications as can be devised and used by the Survey may be of value. By collecting such data systematically the Survey can not only contribute to the improvement of its own future samples, but provide information which may be of use to many other organizations and individuals.

Questions and Recording Schedules

This subject is closely linked up with that of interviewing technique, which is outside the scope of this paper. The present section is, therefore, somewhat rigidly confined to the framing of questions and drawing up of schedules, which is dealt with only very briefly.

Information is collected by means of recording schedules, the fieldworker completing a separate form for each unit (generally an individual, sometimes a household). The form is drawn up so that the information can easily be transferred to punch cards.

In some questions the interviewer is provided with a list of the types of answer which may be made, and is required to classify an answer by putting a ring round the appropriate code number. In others no code is provided, and the interviewer is required to write down what the informant says, either in summary form, or more or less in the exact words used. Which of these methods is used depends on the nature of the questions. Where only a limited number of answers are possible (*e.g.*, number of pints of milk, or type of fuel used for cooking), the code is always printed on the form. Where a wider variety of replies is expected, or where insufficient is known about the problem to be able to forecast the possible answers to the question, the interviewer is generally required to write in the reply. These replies are subsequently coded in the office when the data has been scrutinized and an adequate classification worked out.

Before any recording schedule is drawn up in its final form a pilot survey is carried out. In problems about which there is already much information this serves the purpose of detecting loopholes in the classification, any overlapping there may be, and other sources of ambiguity or error. Where not much is known about the problem beforehand, more is left to the initiative of the fieldworker, whose job it is to find out in the pilot survey the most suitable angles from which the inquiry may be approached. With such problems more than one pilot survey is often needed before the final recording schedule can be drawn up.

The types of question asked fall into three fairly well-defined categories. These are questions on habits, questions on environment and questions of attitude. In addition, fieldworkers are occasionally required to use observational techniques. For instance, in the Lighting inquiry investigators were provided with photometers and were required to measure the light in different specified parts of the house. On another occasion a crockery count was made.

The main difficulty experienced in factual questions is the unreliability of human memory. In many inquiries this does not arise at all, but in some it is of importance—for instance, in obtaining a record of the types of food eaten during a given period. There are two ways in which problems of this sort can be approached. One can pin down the question to "yesterday" or "last week," or one can ask a more general question of the "What do you usually do?" sort. In the first case the replies are open to the errors of memory, in the second exaggeration and bias are more likely to play a part. It is not possible to make any general statements as to which of these methods is more often to be preferred. It must always depend on the individual question.

Questions about which informants are likely to feel some social pressure are occasionally difficult to deal with. Habits with regard to putting out salvage are a case in point. The housewife who realizes she may have been negligent in this respect is perhaps inclined to give replies which are not entirely truthful, whether consciously or otherwise. Sometimes it is possible to introduce check questions, or to ask more detailed questions which will reveal how much reliance can be placed on the answers. For instance, in the inquiry into workers' transport problems, informants were asked how long their journey to work took, and later on at what time they left their homes and at what time they arrived at work. Such an arrangement of questions does not, of course, give a complete check, but devices like this are undoubtedly valuable either in increasing the accuracy of the information obtained, or in indicating how reliable it is likely to be.

The majority of factual questions, however, whether they concern habits or environment, present very little difficulty. Such difficulties as there are are concerned largely with definitions, and it is advantageous to make questions as simple and definite as possible.

Questions of opinion or attitude need more care. There are two great dangers to be avoided in such questions. The first of these is the danger of asking for an opinion where in the majority of cases no formed opinion exists. In general, informants can only give valid opinions about matters which affect them nearly—for instance, rationing, personal transport problems, working conditions, or housing. These are all familiar things which affect peoples' lives from day to day, and about which most have formed a fairly stable opinion, and one which they are able to express in simple terms. To ask for opinions on more remote subjects, involving matters of which people have no first-hand knowledge or personal experience, may give very misleading results. Further, difficulties arise when informants are called on to imagine themselves in situations which are far removed from their experience. This was found, for instance, in the Heating of Dwellings inquiry. Housewives who had been used to a coal fire all their lives were frequently unable to give any meaningful answer to a question asking them whether they would like to have central heating in their homes, because they did not properly know what this would be like. Housing surveys are particularly open to such difficulties.

The second great danger to be avoided in framing opinion questions is that of suggesting an answer to the informant. Questions must be framed in such a way as to give the informant no lead whatever, and it has to be borne in mind also that the questions asked beforehand should not suggest to him any particular point of view on the subject with which the opinion question deals.

The subject of recording schedules and the framing of questions is one

around which there is very much discussion among social research workers. The same, of course, applies to the subject of interviewing. One of the principal issues discussed is to what extent should the method by which the information is obtained be left to the initiative of the fieldworker, and to what extent should one try to impose uniformity and to control the manner in which the interview takes place or in which the questions are put? Each extreme has peculiar dangers. The former method is more open to bias, being introduced unconsciously by the attitude of the interviewer, and the latter tends on some occasions to produce rather superficial information which may conceal the real problem. Much, of course, must depend on the extent to which the fieldworkers are trained, and on the nature of the information required. At present no conclusion can be reached as to the exact amount of latitude that should be allowed to the fieldworker, and it seems best to avoid either extreme until there are further opportunities for research into the subject. At present such opportunities are limited because important decisions on which action is to be based may depend on the results of the inquiries carried out. One needs leisure to make experiments and to try out new methods which have not so far been tested.

Meanwhile the Survey lays special stress on the training of fieldworkers. An attempt is made to give them some knowledge of all sides of the work, from sampling and the drawing up of recording schedules to the way in which the data are dealt with and presented in report form. Each new investigator spends part of her training period in the office learning about these things, and whenever possible lectures are arranged for all investigators. During the course of each inquiry one or two fieldworkers come into the office and help in the drawing up of the schedules, in coding the replies, and finally in computing the results and writing the report. It has been found that this experience is of value in giving fieldworkers a better appreciation of the purposes of the methods used. As a result of such training more reliance can be placed in the fieldworker's judgement in dealing with the various problems that may arise in the course of her work.

Analysis and Interpretation

Recording schedules are sent in to the office daily by fieldworkers. These are first checked, and any omissions or discrepancies found rectified if possible. They are also scrutinized with a view to detecting any bias that might have been introduced unconsciously by the fieldworker. Evidences of such bias are very rarely found, because great care is taken in the training of investigators in this respect, and also most of the subjects tackled by the Survey are not those on which opinion is apt to run very high. There have, however, been occasional instances.

The first stage of analysis consists in drawing up codes by which the replies that have been written in by the investigator may be classified. For this purpose a list is made of the replies on two or three hundred forms selected at random. These are grouped and the code is drawn up from them. The code is then tried out on other forms and any necessary alterations made. When the forms have been coded and the coding checked, the information is transferred to punch cards and tabulated mechanically.

The analyses of the results made depend on the subject of the inquiry, and on what particular information is required by the Department for which the inquiry was carried out.

Results are commonly broken down by region, income group, occupation, age, sex, and urban and rural areas, where these are applicable to the population type. Analyses by number in family, whether or not there are children in the family, married and single, size of factory, and so on are often found to illuminate the results.

Results are generally expressed in the form of frequency tables showing percentages of the number answering. Occasionally, however, the data lend themselves to the calculation of averages and other measures.

In most reports detailed analyses are given only when statistically significant differences are shown between different groups. Otherwise figures for sub-groups are not generally given, and the comment is made that no differences were observed. Sometimes, however, slight differences suggest that it would be worth while to repeat the inquiry with a larger sample. This was the case in the inquiry into workers' transport problems. This inquiry has been carried out three times during different seasons, and after the first inquiry the size of the sample was increased so that more reliable figures could be obtained to show up regional differences, if any. Considerable regional differences were found.

As the samples are large, simple tests of significance are generally all that is needed. In calculating the margin of error on percentages the usual formula for the standard error is used and the 0.05 level adopted. The same applies to averages. Sometimes further tests, such as the χ^2 test or the standard error of the difference between two means, are used. However, as the results are to be used for broad administrative purposes only, small differences between groups are often of little consequence, and there is seldom any need to make use of more refined tests.

The figures are interpreted in the light of the differences shown by the various analyses made, and also reports sent in at the end of every inquiry by the field-workers on the manner in which different parts of the inquiry were received by the public, are sometimes an aid to interpretation.

To illustrate better the type of work carried out by the Survey, summary results of some inquiries and excerpts from reports are given below.

Examples of Inquiries

1. Nutrition.

The Ministries of Health and Food have both been much concerned with the kinds of foods that form the diet of the normal household, how these foods are prepared, and when meals are eaten. Among the surveys carried out were inquiries into what kinds of foods housewives and factory workers ate on particular days, the extent to which housewives use, and their attitude toward, a wide range of manufactured foods, attitudes toward National Wheatmeal Bread and the consumption of manufactured cakes.

The following table shows part of an analysis of foods eaten during a day by men and women in heavy and light industry.

As a second example in this field, in February 1943 the survey carried out an investigation into Canteen, British Restaurant and Café Feeding and Packed Meals. One section dealt with the number of people who ate meals outside their homes, and who took packed meals to work. The policy of the Ministry of

Food has been to provide extra rations for workers by the provision of Canteens and British Restaurants, and it was, therefore, important to know how many and what types of workers made use of these facilities, or what reasons there were for not doing so. The results obtained are of considerable general interest.

Per cent. of Different Groups taking these Foods during a Day

	Female, all (light) industries	Male, all industries	Male, light industry	Male, heavy industry	Total, all industries	Those aged under 20
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Meat, offal	57	65	64	67	64	62
Bacon, ham	29	37	39	33	34	34
Sausage meat	11	25	25	24	24	27
Potatoes	77	81	82	81	80	80
Crisps, chips	26	22	20	24	23	31
Green vegetables	46	48	48	48	47	47
Cooked pudding	34	29	30	29	31	37
Milk puddings	17	22	23	19	20	17
Custard, blancmange	23	18	20	14	20	27
Buns, cakes, biscuits	71	52	57	43	59	75
Chocolates, sweets	6	2	2	—	3	5
Fruit	17	11	14	5	13	17
Sample	1,517	2,962	1,435	1,527	4,490	539

The sample of 4,490 was stratified, the number of interviews in each industrial group being decided in advance and being proportional to the numbers in the population. The interviews were carried out in workshops during working hours.

The following table shows that the majority of people eat breakfast, evening and late evening meals at home; also that 61 per cent. have their mid-day meal at home, or take packed meals to work, and therefore use their home rations.

Where Meals are Eaten

	Breakfast	Mid-morning	Mid-day	Mid-afternoon	Evening	Late evening
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Home	92	3	42	8	84	65
Café	—	4	11	3	2	1
British Restaurant	—	—	2	—	—	—
Canteen	2	15	22	21	3	1
Packed meal	3	30	19	16	3	1
No answer	—	1	1	1	2	4
Nothing eaten	3	47	3	51	6	28
Sample	4,490					

Reasons for not using a canteen where one exists are shown in the next table:

*If Works has a canteen and meals are not taken there—why not? **

	Men	Women
	Per cent.	Per cent.
Easy to/prefer to go home	35	40
Don't like Canteen food	32	25
Used to packed meal	14	8
Canteen overcrowded, dirty	7	5
Have to use lunch hour for shopping or other purpose; can't leave bench	3	8
Prefer British Restaurant or Café	3	4
Canteen not open at right time	3	1
Need a break—fresh air	2	4
Miscellaneous	4	3
No answer	7	8
Number who do not take meals, where Canteens exist ...	870	390

* One person could give more than one reason, and therefore the percentages add to more than 100.

The table below gives the opinions of the people who do take meals in their Canteen, which shows that the majority of this group are satisfied with this method of feeding.

	Men	Women
	Per cent.	Per cent.
Satisfied	69	76
Don't like food	17	10
Not enough variety	7	9
Not enough to eat	11	4
Too expensive	2	—
Too overcrowded	6	1
Miscellaneous	1	—
No answer	1	1
Number who take Canteen meals	965	534

Finally, the reasons for taking packed meals were investigated, and it was found that the greatest number of these fell into two main groups—the fact that no Canteen was available, and habit.

Reasons for taking Packed Meals

	Per cent.
No Canteen facilities	26
Canteen not open at right time	3
Habit, prefer	26
Has to, can't get out, less trouble	18
Too expensive to do otherwise	10
Dissatisfaction with Canteen	9
Have to queue at Canteen, or too far to go	6
Too far to go home	5
Prefer hot meal at night	3
Health or dietary reasons	2
Miscellaneous	5
Number taking packed meals	1,430

2. *Housing.*

Among the surveys carried out in this field are two which were requested by the Building Research Station of the D.S.I.R. They were concerned with the heating and lighting of working and middle-class dwellings. In order that provision could be made for efficient natural and artificial lighting, the Survey was asked to examine a sample of existing houses, to measure and describe their lighting, and to find out what the housewife thought about lighting in relation to the main activities within the house. Similarly, to assist in the planning of heating arrangements a detailed analysis was made of broad groups of heating and cooking apparatus now in use, and of housewives' opinions of various combinations of hot-water supply and heating possible in the future.

To help the Department of Health for Scotland to plan new housing estates, towns, and neighbourhoods, a survey was made to find out what kinds of houses were wanted and what situations were preferred. Information was obtained about the interests and activities of each member of the family outside the home, how often they visited, and how far away they were from the centre of the town. The analysed results were then related to the opinions of the persons interviewed about the distance they had to travel. It was possible in this way to find out how far people were prepared to travel to work, to shop, to church, to the cinema and to many other places of interest without considering the journey inconvenient. This method of relating present experience to wishes has been used to obtain information about other relevant matters, such as neighbourhood qualities, type of house and gardens. Such an appeal is also one way of discovering how far housewives' replies to questions of choice are influenced by the fact that in some cases they had no basis of comparison from which to frame an answer.

The Survey was planned under six headings and it is convenient in this review to give brief extracts from three of them.

The Location of Dwellings in Scottish Towns

Getting a living—the journey to work

In this section individuals within the households sampled were asked how

Relation of Work-Place and Home—Analysed by Distance

Distance of work-place from home	Convenient	Inconvenient	No answer	Sample
	Per cent.	Per cent.	Per cent.	
<i>Working housewife</i>				
600 yards to 1½ miles	95	3	2	265
Over 1½ miles	58	36	5	129
<i>Working husband</i>				
600 yards to 1½ miles	92	5	3	580
Over 1½ miles	57	36	6	507
<i>Unmarried women</i>				
600 yards to 1½ miles	88	10	2	397
Over 1½ miles	49	49	3	237
<i>Unmarried men</i>				
600 yards to 1½ miles	92	5	3	228
Over 1½ miles	59	37	4	194

far they travelled to work, how often they travelled, whether their house was convenient for their work, and how important they felt convenience to be. The table on p. 164 shows the relationship between convenience and distance travelled for the four main groups in the inquiry.

There were no important differences between the times taken over the journey by the different groups.

Running a Home—shopping

Housewives were asked similar questions to those above in relation to local and main shopping centres. The frequency with which they visited these centres is shown below:

Frequency of Visits to Shopping Centre

	Local	Main
	Per cent	Per cent.
Every day	59	14
2-3 times per week	23	24
Once a week and occasionally	7	40
Seldom	10	21
No answer	1	1
Sample	2,461	2,461

Ninety-two per cent. of housewives considered that their local shopping centre was conveniently situated to their home, only 5 per cent. thought it inconvenient. Their attitude toward the main shopping centre was not very different. Eighty-one per cent. thought the main shopping centre convenient to them, and 13 per cent. thought not.

Although these attitudes are very similar, housewives' opinions about the importance of having the two shopping centres convenient to their home were quite different. Some 71 per cent. of housewives thought it very important to have the local shopping centre convenient to their home. Fourteen per cent. considered it somewhat important, and 8 per cent. thought it not important. On the other hand, the proportion thinking it very important to have the main shopping centre convenient to their home was only 42 per cent. Twenty-five per cent. thought it somewhat important and 23 per cent. thought it not important.

The remaining activities and needs were summarized under the headings Care of children, Religious Practices, Leisure Activities, and the Future House.

The Future House

Seventy per cent. of the housewives said they would like to move if they had a chance.

An analysis of the types of houses preferred by housewives who wished to move gave the following results:

3. Health Education

The Ministry of Health has conducted several campaigns to inform the public on the dangers of some infectious diseases and illnesses, as well as to suggest simple precautionary measures, like coughing and sneezing into a handkerchief. The Survey has carried out inquiries for the Ministry into the effects of the Coughs and Sneezes, the Diphtheria Immunization, and V.D. Campaigns, and has at the same time attempted to discover the state of popular knowledge as to the causes of these illnesses. In the Coughs and Sneezes Inquiry, for instance, individuals were asked not only whether they had heard any of the slogans used by the Ministry of Health, but also whether they took any positive steps to keep fit, whether they took any precautions against catching a cold, and whether they knew how colds were spread.

The inquiry into the Publicity Campaign against Venereal Disease was carried out for the Ministry of Health in March and April 1943.

The Publicity Campaign against Venereal Diseases. March 18th to April 17th, 1943

The purposes of the inquiry were to find out the extent to which the Ministry of Health's statements about V.D., published in both the editorial and advertisement columns of the newspapers and popular magazines, had attracted the attention of the public; what was the state of public knowledge about V.D., to what extent people knew what the venereal diseases were and how they were spread; and third to discover what public opinion was with regard to the campaign. This campaign differs from most publicity campaigns carried out by the Government in that it deals with a subject that has to a large extent been regarded as taboo. It was, therefore, of the greatest importance to the Ministry of Health to know whether or not the public approved of such out-spokenness.

A sample of people between the ages of fourteen and fifty was interviewed, men and women being drawn in representative proportions from different occupation groups.

Informants were asked some general questions about health and health education publicity to break the ice before the more difficult subject of V.D. was broached.

It may be noted here that this inquiry was received very well by the public, and proved to be very much easier to carry out than had been anticipated. Although interviewers were instructed to abandon the interview if the informant seemed reluctant to answer owing to a distaste for the subject or excessive shyness, only 3 per cent. of the interviews begun were so abandoned. Sixty per cent. were classified by fieldworkers as "very interested, helpful and willing."

The results of some of the questions are given below:

(1) *Extent to which the statement was seen and read*

All informants were asked: "Have you seen the Ministry of Health's statement telling people about the venereal diseases?"

		Percentage of whole sample	Percentage of those aged under 20	Percentage of higher income groups	Percentage of lower income groups
Had seen statement ...	...	86	71	94	85
Had not seen statement ...	...	12	27	5	13
Doubtful ...	...	1	2	—	1
No information ...	...	1	—	1	1
Sample ...	...	2,459	286	316	2,126

A breakdown by sex showed no statistically significant differences, and results for age groups other than the under 20 group showed no differences.

Those informants who had seen the statement were asked whether or not they had read it through.

	Percentage of whole sample	Percentage of those who had seen statement
Had read statement	72	85
Had not read statement	11	13
No information	2	2
Not asked { Had not seen statement } ...	15	—
{ Interview abandoned } ...		
Sample	2,459	2,085

Analysis by sex again showed no statistically significant differences. Of the youngest age group (under 20) 75 per cent. only of those who saw the statement had read it through. A rather higher proportion of those in the higher income groups who had seen the statement had read it through than was the case with the lower income groups.

(2) Knowledge about V.D.

All informants with the exception of those with whom interviews were abandoned were asked: "Do you know what the venereal diseases are?" The replies were written down by the fieldworker and classified subsequently. Fieldworkers were asked to give informants plenty of time, but not to press for a specific reply if the informant was at all reticent in naming the diseases or describing them.

		Percent- age of whole sample	Percent- age of men	Percent- age of women	Percent- age of those aged under 20	Percent- age of higher income groups	Percent- age of lower income group
Yes	Know all about them	8	11	6	4	11	8
	Gonorrhoea, syphilis, "pox" or "clap"	20	35	25	17	40	27
	Know about them—no descrip- tion	23	20	10	11	28	23
	Know something about them ...	9	6	13	7	9	9
Doubtful	Not quite sure	11	6	14	15	8	11
	Vague answer	6	3	7	6	3	7
No	Don't know	11	7	14	20	4	12
No information	... ..	8	3	3	8	2	3
Sample	... ..	2,459	1,037	1,422	286	316	2,126

(In the first category are included those who made it quite clear in their answers that they knew what the diseases were. The third category includes those who said they knew, but did not describe them.)

There are marked differences in the distribution of answers given by those who had read and had not read the statement.

						Had read statement	Had not read statement
						Per cent.	Per cent.
Yes	Know all about them					9	7
	Gonorrhœa, syphilis, "pox" or "clap" ...					36	12
	Know about them—no description ...					27	16
	Know something about them					9	9
Doubtful	Not quite sure					8	7
	Vague answer					6	20
No	Don't know					5	29
	Sample					1,769	611

Further questions were asked to find out the extent of people's knowledge.

Those who had read the statement were asked: "Did you know about these things before you read the statement?"

					Percentage of whole sample	Percentage of those who read the statement (72 per cent. sample)
Yes, knew before					46	63
Knew part of it before					18	25
No, did not know before					8	11
No information					—	1
Not asked (had not read, etc.)					28	—
Sample					2,459	1,768

Percentage of those who had read the statement.

	Men	Women	Under 20	20-30	31-40	41-49	Higher income groups	Lower income groups
Yes, knew before ...	78	52	35	52	65	78	74	62
Knew part of it before...	17	32	36	31	28	17	19	27
No, did not know before	5	15	28	16	7	5	6	11
No information ...	—	1	1	1	—	—	1	—
Sample (those who read statement) ...	786	982	150	441	586	586	260	1,897

Thus, 36 per cent. of those who had read the statement, and 26 per cent. of the whole sample, had learnt something from the statement, and it is clear from analyses of other questions that those who had read the statement knew more than those who had not.

The results of the inquiry suggest that the group most in need of education

is the under 20 age group, and that men in the older age groups and the higher income groups, are, on the whole, the best informed.

Inquiry into opinions on the statement showed that the overwhelming majority thought that the Ministry of Health was right in giving publicity to the subject.

The purpose of the Inquiry into the campaign for Diphtheria Immunization was to discover how much parents knew about the causes, dangers and methods of prevention of Diphtheria. The Survey interviewed a sample of parents with children under 14 years, and studied the extent of their knowledge of Diphtheria and their attitudes toward immunization.

The Survey covered two types of district in Great Britain: those in which there was a high rate of immunization and those in which there was a low rate. Parents were asked what they knew of the causes of diphtheria, with the following results:

Question 1: "What do you Know about the Cause of Diphtheria?"

Analysis by Economic Groups

Replies to Question 1	Total	Upper	Middle	Lower
	Per cent.	Per cent.	Per cent.	Per cent.
Do not know about it	51	21	47	65
Poor health; being run down	2	2	3	1
Bad sanitation, drainage, smells	17	21	19	13
Dirt	5	4	6	4
Contagious illness	8	10	11	4
Germs	17	26	17	13
Germs in throat: bacillus diphtheria	13	22	14	6
Other answers	1	1	1	1
Sample	2,025	296	806	903

Analysis by "Good" and "Bad" Areas

Replies to Question 1	England and Wales		Scotland
	"Good" areas	"Bad" areas	All areas
Do not know	27	56	59
Poor health, bad sanitation, dirt	30	22	19
Contagious illness, germs	39	20	16
Germs in throat, bacillus diphtheria	16	11	12
Sample	716	862	447

(Percentages add to more than 100 because more than one answer could be given.)

Three-quarters of the parents knew what the dangers of diphtheria were, and 60 per cent. in all groups advocated immunization as a preventive.

In addition to these inquiries, the Survey is now experimenting with a method of obtaining month by month statistics relating to the incidence of illness in the whole population between the ages of 16 and 64. It is hoped that if this method is successful it will be possible to keep a constant check on the health of this large section of the population. The way in which the figures are obtained will also permit of analysis of the figures by age-groups, occupation and certain environmental factors.

4. *The Effects of Publicity Campaigns*

From time to time the Survey has been asked to assess the effect Publicity Campaigns have had upon the population at which they were directed. It has, therefore, tried to discover what particular groups were affected by particular methods of publicity.

Ministry of Information Publications

The Productions Division of the Ministry of Information acts as an advertising agent for several departments. It has the task of preparing publicity material and selecting suitable media for its display. This can be done efficiently only if the types and sizes of audiences reached by different publicity media is known, and the Survey was, therefore, asked by the Ministry of Information to study newspapers, films, and Ministry of Information booklets. This extract is concerned with the audience for the booklets.

The books produced are varied in subject matter, although they all deal with one or other aspect of the war effort. They are well produced, and their price is kept low. The text in all cases is unsensational, although the matter may be exciting, and they are written for an adult audience. Frequent illustrations, mainly photographic, are used to assist the narrative.

For the purpose of this inquiry, attention was concentrated on six books:

	Published	Sales
<i>Battle of Egypt</i>	28.1.43	1,507,000
<i>Combined Operations</i>	18.5.43	1,370,000
<i>Coastal Command</i>	14.1.43	1,167,000
<i>East of Malta, West of Suez</i>	19.3.43	1,093,000
<i>Front Line</i>	30.11.42	1,917,000
<i>Bomber Command</i>	{ 7.10.41 25.8.42	{ 1,360,000 505,000 }

The best seller amongst Ministry of Information publications, *Battle of Britain*, has purposely been excluded. However, all the books considered have sold over a million copies, whilst some Ministry of Information publications have sold many fewer than this. The inquiry is concerned, therefore, with books that have reached medium to large size audiences.

Fifty-six per cent. of the adult population had seen one or more of the six books selected. (This, of course, exceeds the proportion buying one or more books, as each copy bought could be seen by a number of persons.) The table on p. 172 shows the proportions of men and women in different age groups who had seen none, one or two, and more of the books.

Number of Books Seen

Age				None	1 or 2	3 or 4	5 or all	Sample *
				Per cent.	Per cent.	Per cent.	Per cent.	
Men	14-17	...	...	26	29	31	14	152
	18-40	...	...	30	31	24	15	841
	41-45	...	...	31	31	23	15	378
	46-65	...	...	41	30	19	10	897
	Over 65	...	...	64	21	12	3	193
	Total	...	...	37	29	22	12	2,491
Women	14-17	...	...	43	41	10	6	153
	18-40	...	...	45	31	16	7	1,746
	41-45	...	...	43	32	16	8	373
	46-65	...	...	57	25	12	6	795
	Over 65	...	...	71	20	6	3	261
	Total women	...	...	50	29	14	6	3,404
Total (all age groups)				44	30	18	8	5,895

* Slight discrepancies in sample figures here and elsewhere are due to some forms being unclassified in some respects. For instance, in the present table the sample figure for all men is greater than the sum of the samples in the different age groups because a few forms were unclassified in respect of age.

A higher proportion of men than of women saw three or more books, and a higher proportion of women had seen none of them.

The books found a wider audience among younger people than among older people.

Analysis by economic groups is as follows:

Number of Books Seen

Economic group				None	1 or 2	3 or 4	5 or all	Sample
				Per cent.	Per cent.	Per cent.	Per cent.	
Wage-rate of chief wage-earner per week:								
(Lower)	Less than £5	...	...	49	30	16	5	4,399
(Middle)	£5 to £10	...	...	31	29	23	17	1,157
(Higher)	Over £10	...	...	22	25	31	22	286
Total				44	30	18	8	5,895

Those in the higher income groups had more frequently seen the books than those in the lower income groups. A separate analysis shows that of those who had seen five or all of the books, 50 per cent. belonged to the higher or middle income groups, although these groups form but 30 per cent. of the population.

There are very sharp differences between different occupation groups:

Number of Books Seen

Occupation group	None	1 or 2	3 or 4	5 or all
	Per cent.	Per cent.	Per cent.	Per cent.
Housewife	55	26	13	6
Heavy manufacture (operatives) ...	39	32	19	9
Light munitions manufacture (operatives) ...	34	35	20	10
Other light manufacture (operatives) ...	46	33	14	6
Agriculture	70	23	5	2
Mining	53	30	13	4
Building and Transport	45	29	19	8
Clerical	20	33	31	16
Distributive	37	31	22	10
Miscellaneous	42	32	18	8
Managerial and Professional	17	29	28	26
Retired and Unoccupied	59	25	11	5
Total	44	30	18	8
Sample:	5,895.*			

* Sample figures for different occupation groups cannot be given for security reasons, the Ministry of Labour's figures on which these are based being secret.

The books found a wider audience among managerial and professional workers, clerical workers and operatives in light munitions work. Housewives, agricultural workers, miners and the retired and unoccupied group show high proportions having seen none of the books.

Analysis of the results for factory workers by skilled, semi-skilled and unskilled shows a definite trend, skilled workers having seen the books more frequently.

Number of Books Seen

Factory workers	None	1 or 2	3 or 4	5 or all	Sample
	Per cent.	Per cent.	Per cent.	Per cent.	
Skilled	35	34	21	10	843
Semi-skilled	41	35	18	6	479
Unskilled	59	31	6	4	202
All factory workers ...	40	34	18	8	1,540

Analysis by education group is as follows :

Number of Books Seen

Last type of school attended	None	1 or 2	3 or 4	5 or all	Sample
	Per cent.	Per cent.	Per cent.	Per cent.	
Elementary	52	30	13	5	3,904
Secondary or Technical	27	30	27	16	1,536
University	21	25	23	31	144
Others (private, etc.)	36	33	23	8	117
Total	44	30	18	8	5,895

There is a wider audience among those with higher education than among those with only elementary education. An analysis made by geographical regions showed little difference between the regions.

It is shown by this section of the report that the books are not reaching all sections of the population equally well. In particular, some groups of workers, which may be considered important to the war-effort, are under-represented in the audience for the six books concerned.

An inquiry into a campaign of immediate importance was that carried out by the Survey for the Directorate of Salvage Recovery. It was designed to obtain up-to-date information on the salvage habits of the people, to discover which articles could most profitably be the subject of further salvage drives, what were the reactions of housewives to various publicity ideas used in the campaign, and how many housewives knew of the Government's orders making the destruction of certain materials illegal. Some of the same questions had been asked a year previously.

Proportions of Housewives Collecting Salvage

	Always or regularly		Sometimes		Never	
	1913	1942	1943	1942	1913	1912
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Paper	76	79	11	7	13	14
Food waste	79	72	5	4	16	24
Metal	90	72	3	12	6	16
Bones	56	42	11	11	33	46
Rags	56	10	17	13	27	77
Rubber	32	3	9	8	59	89

Sample: 1943, 3,073; 1942, 3,028.

Were there times when you made a special effort to collect salvage?

	Per cent.
Yes	46
No	39
No answer	15
Sample	3,073

What made you do so?

	Per cent.
General national appeal	21
Local salvage drive	32
School children appeal	10
Other people's example	2
Spring cleaning, etc.	8
Can't answer	25

Sample (all who made a special effort): 1,879.

Have you been particularly impressed by any form of salvage publicity ?

	Per cent.
Yes	48
No	39
No answer	13
Sample	3,073

(If yes), by what ?

	Per cent.
Wireless	36
Posters	12
Press	12
Films	11
Loudspeaker vans	5
Local drive generally	4
Pamphlets, leaflets	4
Personal appeals, including school-children	5
Exhibitions	2
No answer	21

Sample (all who have been impressed): 1,877.

5. *Distribution of, and Demand for, Consumer Goods*

A large part of the Survey's work has been concerned with estimating certain consumers' needs, and what difficulties are experienced in satisfying those needs. Other surveys dealt with the working of the various rationing schemes. Some of this work has been concerned with the Ministry of Food's point rationing, issue of cod-liver oil and fruit juices, and advocacy of potatoes. The Board of Trade has, however, required the greatest number of surveys connected with rationing problems. Among these surveys have been inquiries into the use made of clothing coupons, working clothes for certain occupation groups, stocks of pottery in households and breakage rates for various articles of pottery, the use of various types of brushes, and finally the demand for, and difficulties involved in buying, a list of more than thirty articles. This latter inquiry was conducted monthly, and is now carried out bi-monthly. It yields a continuous record of fluctuations in demand for these articles and the difficulties experienced in buying them in different regions. The extract on p. 176 from a table computed for this inquiry is an example of the kind of work involved.

Those housewives who have not tried to buy are asked if they have sufficient stocks of the commodity in question, and, if not, whether they have not tried to buy because of wrong prices, bad quality, or other reasons. Those housewives who have tried and not succeeded are asked why they have not succeeded. Those who have bought are asked if they are satisfied, and if not, why not.

A somewhat similar inquiry is carried out for the Ministry of Fuel and Power to discover the level of domestic stocks of solid fuel. This survey has been made at the beginning of winter and the end of winter.

Have you tried to buy any of the following in the last few weeks?

	Upper income groups				Lower income groups			
	Did you try to buy?		If tried, did you succeed?		Did you try to buy?		If tried, did you succeed?	
	Yes Per cent.	No Per cent.	Yes Per cent.	No Per cent.	Yes Per cent.	No Per cent.	Yes Per cent.	No Per cent.
Scrubbing brushes ...	18	82	46	54	24	76	31	69
Other than tin kettles ...	14	86	14	86	12	87	9	91
Saucepans ...	18	82	27	73	24	76	22	78
Cup, mug, beaker ...	23	77	65	35	26	74	63	37
Mending wool ...	29	71	79	21	27	73	78	22
Towels ...	10	90	91	9	10	90	88	12
Cotton or linen sheets ...	11	89	16	84	13	85	10	90
Men's boots or shoes ...	13	79	98	2	11	89	93	7
Women's boots or shoes ...	24	76	73	27	18	82	80	20
Sample: 726 = 100 per cent. Those who tried = 100 per cent.				Sample: 2,161 = 100 per cent. Those who tried = 100 per cent.				

In addition to the material the Survey collects on such specific problems, data are derived from the classification of material gathered on surveys. This is used by the Survey to build up its knowledge of the basic properties of the population, such as family size, number of children per family, number of wage earners per family, age groups of housewives and women in industry, the number of rooms per household, the proportion of houses to flats, how many are living in hostels, at home, or in lodgings, and so on. With the aid of this material the Survey is able to check its samples very closely, and provide the necessary data for many of the surveys it may be called upon to do in the future.

The Survey in the future

It is apparent from this brief outline that in its fairly short existence the Survey has touched on many fields of work where available data were limited or non-existent. A point has now been reached in its work where separate lines of research are beginning to link up. The consequent advantages should be great. Future inquiries can now be made on a foundation of fact which will permit not only of broader generalization, but a more exhaustive analysis of the elements involved in the problems they present. At the same time there are clear indications of the ways in which the Survey could be of considerable assistance to the working statistician in several Government Departments.

The material the Survey has collected on food and diet, clothing and fuel stocks, is obviously of importance to those who are engaged in estimating real costs of living. The methods by which this material was obtained could be developed to enable cost-of-living indices to be kept up-to-date to a far larger degree than is possible at present. It is of interest to note that in the United States regular sampling inquiries are carried out by the Bureau of Labour Statistics to establish its cost of living index.

Those Departments which are concerned with social security measures

could, no doubt, make use of such figures in deciding policy, preparing estimates, and assessing the effects of changes in their regulations, while if this country is to have a nutrition policy after the war the only check than can be made upon its effect is by means of regular dietary surveys of the kind the Survey is developing.

Similarly information collected on the incidence of illness not only provides fresh material for epidemiology, but might also be the basis for a system whereby the Ministry of Health could promote preventive measures at the outset of an epidemic much more speedily and effectively than is now possible. In addition to this, social medicine might be much assisted by analysing information about illness in relation to environmental factors, occupation and age, which the survey method makes possible.

In the field of housing and planning of towns and neighbourhoods many problems of estimation arise for which there has been, in the past, little reliable data on which to work. Details of the family size of those who would be rehoused, their requirements in terms of rooms, cooking and heating apparatus, and their attitudes toward the distances they may have to travel to such amenities as shopping centres and cinemas, and the distance they might have to go to their work, are all involved in planning houses and estates. The magnitude of the problems involved in planning post-war building is such that there seems no other way of solving them rapidly and inexpensively.

Problems of a similar nature will arise for those concerned with education. The provision of places for various types of schooling and the location of those types of schools throughout education areas are both matters of immediate and lasting concern to education authorities.

Lastly there is the general point that the Survey can provide a closer link between the administrator and administered than is normally possible, particularly in relation to the preparation and interpretation of Departmental Statistics.

In its recent Memorandum on Official Statistics, the Society points out that in the past Departments of State have collected data for certain limited purposes only, customarily by means of a return. This was largely because of the unwillingness of Parliament to extend to the Departments unlimited powers to demand such information compulsorily, compulsion being the only way of ensuring a sufficient proportion of returns to give reliable results. It has followed that in each Department there has been a large amount of unco-ordinated statistics related to very limited aspects of the Department's work. By the extension of the survey method such obstacles can be overcome. Thus the data which it is most convenient for a Department to obtain by a return can be supplemented in many ways by sample inquiries, before the Department has to make decisions of policy related to the purpose for which the return was made. There is no doubt that in this way a most flexible instrument for the compilation of a wide range of statistics can be developed. At the same time each Department can, as the Society suggests, remain in close touch with the collection of data, since the Survey normally discusses an inquiry in great detail with the officers concerned before it goes into the field.

The experience of the Survey has shown during the past two years that its work has satisfied a real need for a specialist body able to advise on aspects of social inquiry which go beyond the official return. There is little reason to suppose that this need will disappear when the war comes to an end, and if the Survey's wartime work has indicated a way in which the need can be met then it will have achieved much more than its immediate objectives.

DISCUSSION ON "THE WARTIME SOCIAL SURVEY"

DR. BRADFORD HILL, in proposing a vote of thanks, said: In a remote village in which I live a farmer a short time ago endeavoured to commit suicide. "No wonder," said my informant, "the postman never took him less than twenty letters a day and nearly all of them forms to fill up." This, no doubt, Dr. George, on behalf of the Ministry of Agriculture, will say was a gross exaggeration; Mr. Kendall will protest against deductions based upon a sample of one. While I freely admit the force of those criticisms, I still have the feeling that perhaps there are too many forms, too many involved and difficult forms, sometimes—not necessarily invariably—crystal clear to their designers, but rather akin to mud to some of the recipients. Perhaps my farmer could cart muck or milk cows and at the same time be cross-examined by one of the trained field-workers of the W.S.S., and still retain his mental balance. While Miss Box and Mr. Thomas have made no such specific claims on behalf of the Survey, they have given us a most interesting paper on the methods the Survey employs for collecting statistical information about the population over a very wide range of subjects.

Their work, as they point out, falls naturally into three distinct sections—(1) selecting a sample that can safely be regarded as representative of its parent population, (2) framing and putting such questions as can be expected to lead to answers which will throw a proper light on the matter under investigation, and (3) analysing the resultant statistical data and drawing the appropriate conclusions.

The first is, of course, fundamental. If a proper sample cannot be drawn, the whole procedure must more or less fall to the ground. While clearly labouring under some difficulties, the Survey does much to make its samples representative. There is, however, one point of some importance which is not mentioned—that is, that their samples are, naturally, samples in time as well as space. For instance, one of their enquiries related to the number of articles of domestic crockery that the average household breaks in a year. It is, of course, idle to ask the housewife what she has broken in the past year; even the best memories will not run to that. Indeed, there was some evidence that she could not accurately state what had been broken in the previous week. But allowing that that period of time gives reasonably good data, it would be necessary to note that the results would be true of the week when the enquiry was carried out, but not necessarily true of other weeks. The "expectation of life" of a cup and saucer may very well be much less in the months of cold fingers and black-out lighting than in double summer-time. In other words, multiplying the sample week by 52 to reach the required annual estimate might lead to materially different results according to the date of the enquiry. A better procedure would clearly be repeated samples at different points of the year; but, then, as the authors point out, they are faced with the difficulty that an answer is often required urgently. It seems to be a problem with which they may quite often be faced, and their answer to their "client" may have to be that there is no quick way of "getting rich."

On smaller sampling issues there are one or two questions of general interest. It is stated that "the Survey relies on educating the field-worker to understand the need of avoiding bias in selection, so that she may adapt herself to different situations and devise suitable methods." Experience shows that quite sensible people often have the oddest ideas about what is suitable in sampling processes. Are the field-workers in each enquiry required to report on their methods so that a central check can be kept upon them?

It is also said that some checks have suggested that the loss of randomly selected informants through absence at the time of the field-worker's call is not always important, and that in such cases substitutes are taken, generally the housewife living next door. On the whole, this seems to be a dangerous procedure. It is clear that a reply to the caller is more likely to be received from some types of households than others—where, for example, there are young children to be

looked after. The more frequent presence of these families must bias the sample in a particular aspect and substitutes for the absentees would increase that bias. It may be that the bias is not always important in relation to the points under investigation, but one would want very good proof of that. Perhaps the authors would give some examples of the checks they refer to.

On a final sampling point, they say one of the difficulties they have to contend with is illness of the field-worker. To keep to the originally chosen sample, presumably a substitute field-worker is employed. But what about the illness of the informant? This might have an influence on some of their enquiries—for instance, the national morbidity index. This index is based upon the informant's health history over the previous three months. The absence from the sample of those ill at the time of the field-worker's call would lead to too favourable a picture, though possibly the error is relatively slight.

Turning to the framing of appropriate questions, the unreliability of human memory is pointed out, and two alternative approaches are given. "One can pin down the question to 'yesterday' or 'last week,' or one can ask a more general question of the 'what-do-you-usually-do' sort. In the first case the replies are open to errors of memory, in the second exaggeration and bias are more likely to play a part." But these two methods are not simple alternatives; they often lead to two totally different kinds of results. To take an example, in an enquiry into meals eaten one might, to ensure accuracy, tie the informant down to meals eaten yesterday. But this will lead to the picture of the population's characteristics on any given day, and not of the habits of the individuals composing that population. Whether it is the right form of question depends entirely on what information is required. For instance, it might be found that 5 per cent. of young adult women went to work without breakfast on the previous day. That figure, then, is an estimate of a characteristic of that population; but it obviously cannot be deduced that a certain 5 per cent. of young adult women habitually go to work without breakfast. It may be a different 5 per cent. day by day. That 5 per cent. on any day should over-sleep themselves and have no breakfast is perhaps quite unimportant; that a certain 5 per cent. *always* go without breakfast might be important. To find that out one must have a question directed to usual habits.

This leads to a final comment which concerns both the framing of questions and the interpretation of results. The interpretation of statistics demands familiarity with the field in which they lie. Though all the enquiries of the Survey lie in a very broad sense in the social sphere, they cover a very wide range—from clothing needs to venereal diseases, from digging for victory to sound in dwellings. Presumably the Survey works in very close contact with its users, for that seems to be a fundamental requirement. Unless those who know the subject-matter under investigation co-operate with the Survey, there may be a serious risk of the latter asking questions to which no reasonable answers can possibly be obtained, or reaching dubious conclusions through overlooking pitfalls that only those experienced in that field would be aware of. Equally important is it that conclusions should be drawn, and not that the Survey should say, "we don't know enough about this subject, here are our tabulations." That would give the user with a knowledge of the subject, but no statistical acumen, a free hand to draw erroneous deductions. The solution lies in the closest collaboration between the Survey and its "clients," both in framing the enquiry and in interpreting its results, the Survey acting alone only as the collecting agency. Given such collaboration, it should do very valuable work in supplementing official statistics collected by other means or in acquiring data on questions which cannot otherwise be at all efficiently or easily dealt with.

DR. C. OSWALD GEORGE, in seconding, said : Hitherto a good deal of mystery has surrounded this type of survey, and it is a matter for satisfaction that by the presentation of this paper, on which the authors and other officials concerned are to be congratulated, some of that mystery will be dissipated. The value of the results is obviously increased when the persons responsible for them

are not afraid to submit their methods for public comment and criticism. I foresee the possible development when some future Government may decide to treat Social Survey enquiries even more stringently than patent medicines and require a statement to be made on each one, showing the precise methods and conditions under which it was produced.

The present paper covers several surveys; comment might have been facilitated if it had been limited to one survey, when more detail might have been given. As it is, one is in rather a dilemma; if comment is limited to the broad method, there is a danger of being discursive; on the other hand, one has hardly sufficient detail of any survey to make effective comment. Take the rather astonishing results of the venereal diseases survey, where 11 per cent. of the men, 8 per cent. of the women, and 4 per cent. of juveniles who had read the statement about the diseases, were said to "know all about them." We cannot tell if this were due to defective sampling; did the sample contain an unduly large number of Harley Street specialists, or quacks, or still less reputable people? Or had the phrase "know all about them" some peculiar connotation, or was it merely a misprint for "know about them all"?

A striking feature of Social Surveys is the opposition they have aroused, which seems based mainly on four grounds:

(1) The feeling that an Englishman's home is his castle;
 (2) The opposition often aroused by any method believed to be an entirely new departure. But is it really new? I am not quite sure that it is. In the oldest book I know on statistics, published under the title *Numbers*, there is a reference to an old gentleman named Moses who made enquiries about families, and it may be assumed that he adopted some of the methods of the Social Survey, although he may not have been satisfied with the sample.

(3) The belief among the uninitiated that little can be done by the method of sampling; but this will hardly be received with sympathy here.

(4) The doubt whether the method is suitable in the cases to which it is applied. This starts several trains of thought. Can the information required be effectively obtained by means of a question to the public? Can the necessary questions be so framed that the informants are able and willing to give the required answers. The questions should obviously be unambiguous and preferably, I think, of the type to which simple answers may be given. With the type of question to which each informant can give several answers, doubts and problems may arise. Take the Table dealing with the reasons for not having meals in a canteen, where it will be found that the percentages of answers given by men add up to 110 and by women to 107. Are we to suppose that women are less imaginative than men in finding reasons for not taking meals in the canteen? In the next Table, giving the opinions of the people who do take their meals in the canteen, the percentage of answers given by men here add up to 114, but by women to only 101. Is it not strange that women can find only an additional 1 per cent. of explanations? When we come to the third Table, showing the reasons for taking packed meals given by the whole sample—where the third item, "habit, prefer," might alone be expected to have reached 100, the percentages add up to only 113.

This gives rise to the doubt whether the percentage of answers given to questions of this type does not depend on the person who asks them. Women may be more impatient towards a woman questioner. A good deal may depend on the personal characteristics of the questioner or the informant.

With regard to the randomness of the sample, is there any check on the investigators and on their visits? And has any analysis been made of the answers reported by the various investigators? May we investigate the investigators?

One further point: it would be an advantage if in each Table we could have a clear statement of the number of persons who have not given complete answers. In this connection I was disturbed to find that connected Tables show items adding up to different totals. For example, in one Table we find that 1,769 people had read the statement concerning venereal diseases. But in the next Table, males

and females add up to only 1,768, and one speculates why the sex of one informant was indeterminate. When we pass to the distribution in age groups, the total drops to 1,763, and here it is possible there were five ladies whose age was uncertain. But in the income grouping the total rises to 2,157, and it is difficult to see where they all come from.

I should like to comment on the adequacy and other features of sampling, and on the suitability and control of stratified sampling, but time does not permit, and I can only repeat my congratulations to the authors and the department on presenting the paper to us.

PROFESSOR MAJOR GREENWOOD said that the difficulty which he experienced concerning the paper was not with regard to the statistical technique, but rather with regard to the distinction between questions of fact and questions of opinion. He instanced the enquiry into the use of the canteen. There, assuming the sampling had been adequately done, one had a certain number of persons who had an opportunity of using the canteen, and of this number a certain proportion did not use it. That seemed to be a question of fact, and within the limits of sampling it did answer a question which was important to a Government department. Again, take the enquiry into knowledge concerning venereal diseases. The Ministry of Health, he gathered, wanted to know what proportion of the population had seen its advertisements. There, again, provided the sampling had been adequately done, an answer of a factual character furnishing the required information was forthcoming. But it did seem to him possible that, having tasted blood, people who initiated such enquiries had their appetites sharpened too much. The canteen question did not touch any particular emotion, but when one asked why people avoided a canteen he recalled the old rhyme:

"I do not like thee, Dr. Fell,
The reason why I cannot tell."

Surely a decision was often based on all kinds of obscure, unexpressed, and emotional reactions on the part of a user or non-user of a restaurant or canteen. A man might decide not to go to one of those places any more, and his real reason for that decision might be that an infernal bore always sat opposite to him at the same table. But when questioned on the subject he would say nothing about the bore, but would perhaps say that the food was bad, and his non-use of the restaurant would be put down to that.

That was one of the difficulties when it came to the classification of opinion. An old colleague of his told him that his father, who was, he thought, a Non-conformist, did not approve of his boy going to a Church of England service, and raised the matter with the headmaster. The headmaster said, "Well, we can only excuse Jews from attendance." "Right," said the father, "put me down a Jew." He wondered whether the sub-classification of reasons for not using the canteen really had any great value. As to the Table concerning knowledge of venereal diseases he was very sceptical. They were told that 87 per cent. of the population had seen the statement and 75 per cent. had read it. Could the difference between these percentages be regarded as factually as well as statistically significant? That was the difficulty—more might be read into these data than they could bear. If the Survey confined itself to matters of fact and left matters of opinion alone, it would be very valuable.

Another point had been raised by Dr. Hill concerning fluctuations in time, as in the case of the breaking of crockery. Opinions that one would give this month on some large issue might be very different from opinions that were given last month or that would be given a month ahead, because one's mood was different.

MR. J. GOLDMANN said that the paper was of special interest to all who were working in a similar field. The method of interview enquiry was the common property of most research organizations, and with this method there would be

little disagreement. One point on which he desired amplification was the testing and verification of the results obtained. It was only after thorough examination of the sample, of its consistency and its agreement with all available information, that results should be accepted. He gave examples to show how the results of a sample enquiry by interviews might be subjected to fairly rigid tests, and would in most cases stand up to such tests. In an enquiry by the British Institute of Public Opinion on family income and savings the percentage distribution of incomes by size as obtained for the sample was applied to an estimated number of households, and the totals were compared with the figures in the White Paper on income and expenditure. It was found that the figures were in rough agreement, although, of course, there were certain complications, especially in the high-income ranges. Actually the test was extended to the shape of the income distribution. He showed how the test was applied by plotting a Pareto curve and how it could be adapted to similar enquiries.

A second line of approach in checking the reliability of the sample was the test of its internal consistency. If a sample was broken down, say by sex or economic groupings, figures for the sample would show stability even when the groups were fairly small, provided correct methods had been used. Samples might be broken down by interviewers and comparisons made between the results obtained by different interviewers. The basic idea behind this statistical analysis of the variation between interviewers was similar to the methods used in "Quality Control." Its applicability to social surveys was mentioned in an exercise in Yule-Kendall's "Introduction," but, so far as he knew, no report on its actual application had yet been published.

Nobody would hold that sampling could replace the census, but the proper function of a sample enquiry was to supply statistical data wherewith census data might be supplemented, and it was of great use where the census was not sufficiently comprehensive or sufficiently frequent.

MR. REDDAWAY said that his general attitude towards the paper was one of real support. He wished to concentrate on the question whether and when one could expect correct answers from the people interviewed. His own experience had been very clear, that the problem of getting a proper sample was of almost no importance relatively to the question of getting accurate answers from the people interviewed. At least by comparison, the question of accurate answers outweighed the question of accurate samples beyond all measure. The difficulty about it was, of course, how to know when one had got an accurate answer. If one knew the result which the enquiry should yield, one could tell whether the answers given were, on the average, right. But including questions like, "Are you a member of a trade union?" or "Did you own a car before the war?", designed to check the *representativeness* of the sample, could not help one in the least.

Take the breakages of crockery. Dr. Bradford Hill had very reasonably cast aspersions on the method of asking people how much crockery they broke in the course of a year, because the memory was not reliable enough for this, and had considered an enquiry based on a week's breakages to be better. But the answer was now more or less known, because the accurate figure for the crockery made in the course of more than two years was known, and sample counts were taken of the amount of crockery in people's houses at various dates. If one took the breakage rate based on the "one-week" figures and calculated how much crockery ought to be left in people's houses after two years, then on nearly every item the answer was a minus quantity. The method of asking people how many cups or plates they broke last week gave an answer which in no single case was less than three times the current rate of production, and in some cases ten times the current rate, yet the actual current production, while he would not say that it had maintained the domestic stocks, had left them not very much reduced.

It was highly desirable, therefore, wherever possible to check the results *ex post facto*, so as to see what type of question produced accurate answers. At

the time the sample was taken they had had little idea how adequate the current production was to meet the breakages, but by starting from production figures they got results broadly similar to those worked out on the basis of asking people how much they had broken over a year, and later information had shown these estimates to be broadly correct.

In giving the number of articles broken over the last year, people had doubtless made all sorts of individual errors, but they had presumably cancelled out; at all events the results came out well within the usable and useful limit. But when people were asked whether they broke anything last week, the results were absolutely worthless. The most probable explanation was that to a considerable extent people had guessed the answer, and the guesses must have an upwards bias, since much the commonest answer was found to be 0 and you could not have compensating downward errors.

One other enquiry which was of some interest in illustrating the exaggeration obtained on compressing experience into a short period concerned razor blades. Men were asked: "Did you insert a new blade in your razor this morning?" The number who said "Yes" out of about 800 was 132, which was far more than was possible on the basis of the supplies of blades actually being produced. But when the supplementary question was put: "Did you insert one yesterday?" the answer "Yes" was given by only 39. That was the sort of problem where a test of consistency was needed.

If the question was one to which the majority of answers ought to be "No," one had the very serious problem of eliminating the upwards bias. When the straightforward question was asked: "Did you break a cup last week?" the answers were by no means the correct ones, as was now known. Dr. Bradford Hill had suggested that with such a problem the one week taken might not be representative. But the present speaker doubted whether anyone would suggest that any one week produced three times more breakages than any other. And if it were suggested that the large accident rate was due to gloomy weather conditions, the week taken was in June, 1942.

Mr. L. Moss, as one of the workers in the Survey, welcomed the kind of criticism they had had that afternoon. It was the bugbear of statisticians and economists working in Government departments that they were frequently asked to advise on policy with very limited material to go upon, and when they suggested that more information should be collected, they were apt to be met by opposition from those who did not want the department to go out and speak to the people about their problems. The kind of technique used by the Survey did largely get over that difficulty, and enabled the information to be obtained in a relatively economical and time-saving way. It was mentioned in the paper that the proportion of refusals to give information was not more than 0.5 per cent., a mere ripple on the general current of public opinion.

It was recognized that the method was very young, not indeed so far as the idea was concerned, but in the sense that the techniques which had been developed were relatively crude and unrefined. That was the reason for the difficulties and mistakes which were quite common in this type of work. Mistakes must be taken into consideration, and the technique changed accordingly in order to avoid them in future, and, above all, not too much should be read into the results of the enquiries.

One method of increasing their knowledge and improving their technique was to make full use of all the enquiries of this kind which had been undertaken, and to check the results of their own enquiries with those of other organizations working in the same field. The more they could do to get publication of this kind of results, the more they should be able to improve their technique and to make a really workable instrument of the kind of method described in the paper.

MR. MADGE said that the authors were old colleagues of his, they had tramped together down many a street, and it was a personal pleasure to pay them a tribute. He agreed with other speakers as to the special importance of this occasion,

which marked the first public statement of what the Wartime Social Survey had been doing. They had all known of its existence, and some of them had seen certain of its results, but it marked an important new phase in its history when it came into the field of informed criticism. He had a feeling that in this country possibly Government departments had been less anxious than they should have been to publish this sort of material, while in other countries, particularly America, Governments had gone to the opposite extreme. But he felt that more was lost than could be gained by delaying publication of the results for too long. In other cases where Government had undertaken quite large enquiries statisticians and others had been deprived of the use of them in their own publications. If an organization like the Social Survey was to have its maximum usefulness the question of publication was extremely important.

A Social Survey which was under the aegis of the Government was in a particularly fortunate position compared with other organizations which had to depend for their livelihood on publication or on the exclusiveness of their information. This Social Survey was collecting information in the public interest, and therefore it was very important that the public, particularly the scientific public, should be kept fully informed of what it was doing. He liked the amount of detail which was given on the methods. Anybody who had done this sort of work must feel that, interesting as the results of certain enquiries were, they were less important in a way than the exploration of potential methods. There was much that was illuminating in the present paper. The only question he would raise was on the subject of the income groups. Where one was dealing with factual information about behaviour at different income levels, the method adopted by the Social Survey was not sufficiently refined for any but the broadest comparisons, since so much depended not only on the occupation of the main earner, but on the size and shape of the family. This was a field which the Social Survey should definitely try to conquer.

There was an indication in the paper that the methods of the Social Survey might be used for improving the cost-of-living index. In order to apply the method to that problem, it would be necessary vastly to improve and standardize the manner of dealing with income groups. In general, the most pressing need was for a raising of the technical standards and for ensuring that any façade, whether academic or other, was not such as to prevent interested practitioners in this field from penetrating in order to produce a cross-fertilization of ideas and methods. Any enquiry of this kind represented a considerable investment, and therefore there was some tendency to be cautious in the methods used, whereas if the thing was on a smaller scale one was not so much afraid of the results turning out negative. Small surveys might carry out experimental work, to be carried further by large ones. The Wartime Social Survey was evidently, from the present paper, willing to learn from experience and to admit that they were only at the beginning of things. It was an organization which did not find it necessary to sell itself by building up too elaborate a façade of completeness in its information. The most important result of the first publication of the Survey was that they would all be able to go away and think over these results and compare notes (that is to say, those of them who were engaged in the same field), and he hoped there would be some arrangements by which they would be able to compare not only results but methods in this field.

MR. FERRABY said that "Mass-Observation" was very grateful for this present paper. He did not want to repeat what had been said by many speakers. One point of criticism of the methods of the Wartime Social Survey was that since they had a large staff, access to information which other organizations had not, and in many ways were in a favourable position for doing this sort of work, they might occasionally let that favourable position mar their work by using a sledge-hammer to kill a gnat. Their very elaborate technique was necessary for many investigations; but there were some for which such an elaborate technique was not necessary; and the Social Survey was tending to use the technique in its entirety for investigations in which something less elaborate would serve the

purpose. In the Health Survey, for example, it seemed to him that if the figures were less accurate it would not have made a great deal of difference to the department, and time and expense might have been saved by the use of a modified technique rather more appropriate to an investigation of this kind.

Professor Greenwood had stressed the difference between the investigation of facts and of attitudes. That was a difference which "Mass-Observation" had been trying to stress for a long time. The Wartime Social Survey was much more suited for the investigation of facts than of attitudes. Attitudes were very vague things, and could not be exactly defined. An attitude was not an easy thing to measure, and consequently did not lend itself to the method of accurate counting. But numerical manipulation was not the only way of dealing with attitudes. He would suggest that if it were thought that attitudes were not susceptible to exact numerical treatment, the survey method of investigating them should not be condemned entirely on those grounds, but a search should be made for supplementary non-numerical methods which could be added to the numerical methods in order to give a result which was really scientific.

Mention was made of testing results by internal consistency. If several simple investigations gave consistent results, consistent both numerically and qualitatively, the chance of the group of results taken together giving the right answer might be very much bigger than the chance that a single investigation on a more extensive scale would do so. It was the consistency of the related parts—which was not entirely internal consistency, because they need not all belong to the same sort of investigation—which was important.

He wished to conclude with a remark on the youth of this science. It always seemed to him rather apologetic to say that a science was young, but he did not think that the results in the field of Social Survey need be apologized for. The results were far from perfect, but so, he suspected, were the results of the most fully developed science. The real question was whether this method produced results which were more reliable than those obtained by any other available method, and the available methods were very few. With regard to attitudes, there was no other method except a collection of subjective judgments. However inadequate the results of the Social Survey might be, they were infinitely preferable to the results of guesswork.

DR. RUTLAND said that this Survey had shown what could be done by this method, and even some administrators were coming round to the view that there might be something in the method. The Wartime Social Survey had no axe to grind, it had no political or commercial pressure to exercise, and it was all the more valuable as a source of unbiased information on problems of reconstruction. He would have liked to have seen a stronger justification of the claims made concerning the method of sample stratification. They were told that samples were analysed according to the occupation of the chief earner, and that by this means investigator bias was removed. The five groups mentioned had very wide gaps between them, and it struck him that in the interpretation of these gaps, bias, or subjective feelings, must enter. Attention had already been drawn to the difficulty of stratifying by incomes, and it seemed to him preferable to admit that the standards used were not entirely objective. The question of social stratification was complex and a great deal of fundamental research was yet required to determine what types of classification were the most useful and how they should be defined.

The need for this type of information was extremely urgent and obvious to everyone dealing with social problems. It would appear that it could be met by a survey, repeated whenever necessary, and linked up with such information as existed.

MR. THOMAS, on behalf of Miss Box and himself, thanked the members for the careful way in which the paper had been considered and discussed, and said that he and his fellow author proposed to avail themselves of the opportunity of replying in detail in the *Journal*.

DR. PERCY STOCKS, who was unable to attend the meeting, wrote: I should like to have been present at the reading of this important paper, but pressure of work makes it impossible. The efficiency of an organization such as this can best be proved by the results of its work, and I have recently had the pleasure of being associated with the Wartime Social Survey in an experiment in which I had a paternal interest—namely, the monthly enquiry about incidence of illness which is referred to on p. 171. In that experiment monthly samples of the civilian population of the working ages were questioned in detail about the illnesses and injuries which they had suffered during each of the 3 months preceding the interview. For the month of December rates of incidence of various categories of illness were thus obtained from 3 independent samples, and for November and January from 2 independent samples. Comparison between the resulting rates provided a stringent test of the validity of the assumption underlying most of the work of the Wartime Social Survey, namely, that their sampling processes are substantially free from selective bias and provide reliable guides to the position in the whole population from which they are taken. I embarked upon this test with some trepidation, owing to doubts firstly as to the willingness of people to give all the information asked for, secondly as to the manner in which the schedules would be filled in by the field-workers, and thirdly as to the results of comparing separate samples covering the same month of experience. Under each of these heads the experiment succeeded far beyond my expectations, and credit for this devolves alike upon the field-workers and upon those who organized the work and devised the sampling processes.

One or two examples of the consistency of the results obtained will substantiate what I have said. Illnesses were coded according to the Medical Research Council's Classification by Ministry of Health coders experienced in that work, and were then grouped into defined categories of severity according to an agreed plan arrived at with the help of Professor Ryle and Dr. J. A. Glover. For "serious" illnesses the rates of incidence per 1,000 at risk in the month of December in the 3 independent samples, taken from different localities spread over the whole country, were 20 in each case, the standard errors being about 3. For "moderate or mild" illnesses (defined as those likely to produce incapacity for at least 3 but less than 28 days) the incidence rates per 1,000 at risk for the same month were 151, 148 and 157 according to the 3 samples, the standard errors of the difference being 10 or 11. As a result of questions as to the frequency of visits to or visits by doctors during the winter months, one sample gave a daily average of 17·4 per 1,000 persons of the working ages and another sample gave 18·4, the standard error of the difference being 0·9.

On p. 159 reference is made to errors of exaggeration and of memory, and these have to be kept in mind where the form of the question, circumstances under which it was asked or lapse of time before asking it make it probable that one or other of these errors was statistically important. An example was furnished by a comparison of the frequencies of colds and alleged slight attacks of "flu" during November and December, as recorded whilst the influenza epidemic was still present in one sample and as recorded after it was over in another sample. The latter rates were about three-quarters of the former. This might have been due either to exaggeration whilst everyone was epidemic-conscious or to a normal fading of memory for very slight illness. That it was probably due to a return to a more normal assessment of what was worth mentioning is suggested by the fact that the January rates for colds and influenza showed no significant difference between two samples of people interviewed during February and March respectively.

The success of this experiment has been such that it is hoped to continue it in order to obtain continuous indices of the trends of various types of illness. With such an instrument at our disposal as the Wartime Social Survey provides, I believe the statement by the authors of this paper that "social medicine might be much assisted by analysing information about illness in relation to environmental factors, occupation and age, which the survey method makes possible"

to be well founded, and am confident that its truth will be demonstrated in the near future.

THE AUTHORS replied to the comments, as follows :

Dr. Bradford Hill raised some points about sampling. He said the samples taken are "samples in time as well as in space." This problem arises when information is wanted about the general characteristics of the population, or its characteristics over a longish period, when seasonal or other variations with time occur. Dr. Hill's suggestion that such enquiries should be repeated at different points in time would no doubt be the most satisfactory method, and the bi-monthly enquiries made for the Board of Trade into the supply position of various domestic commodities illustrated this. It would be misleading to regard the results of any one of these enquiries as representative for the whole year, but consideration of all the enquiries carried out during a year gives a picture of the position that year. When enquiries of this sort cannot be repeated it is necessary to tell the department wanting the information that there is no short cut, or to give them only part of what they require.

Professor Greenwood also raised the point of "samples in time" with regard to surveys of opinion. The results of these surveys are represented as true only for the time at which they are carried out. Sometimes opinion questions are repeated to find out what changes there have been. The Survey has, for instance, asked people what they think of National Wheatmeal Bread four times since it first appeared in the shops.

In answer to Dr. Bradford Hill's question about the selection of individuals, whenever possible fixed rules are laid down, but when this is not possible investigators have to use their initiative. They report on sampling problems at the end of the Survey so that a check can be kept on the methods used. As the Survey's experience of taking samples from different populations increases, there will be less need for investigators to devise methods, because it should be possible to draw up a set of rules to meet all circumstances.

With regard to Dr. Hill's question about substitution in housewife samples, the interviewer's working time is spread over the day, and the main danger is that of missing housewives who are out all day. The majority of such housewives are workers, and sometimes separate quotas of working housewives, to be interviewed at their place of work, are given. As a further precaution, interviewers are asked to select so many housewives from three different age-groups. Samples of housewives including substitutes, and a sample of the adult civilian population in which workers are interviewed at work and housewives at home, show no statistically significant differences in the number of children aged under 14 per family. This suggests that substitution is unlikely to bias the sample in respect of families with and without children.

In the morbidity index enquiry the questions can be answered by a near relative of the informant. When the informant is ill, or is unable to be interviewed for any other reasons, interviews are carried out by proxy. It has been found that reliable information can be obtained in this way.

Dr. Bradford Hill said that questions about "yesterday" or "last week" do not reveal habits. The truth of this criticism is recognized, and in recent enquiries the Survey has avoided framing questions in this way alone when information about habits is wanted. The device is used generally when a picture of the situation at any particular point of time is wanted, and also for checking or supplementing information given about habits. For instance, in an enquiry into newspaper-reading, informants were asked both "Did you see a morning paper yesterday?" and "How often do you see a morning paper?"

With regard to the last point made by Dr. Bradford Hill, the Survey works in close collaboration with the departments concerned. Also research officers specialize in particular subjects—housing, food, health, etc.—so that each research officer gains increasing knowledge both of the background of his subject and of the special needs of the department with which he is working.

Dr. George commented on the results given as examples of the Survey's

work. Our aim was to illustrate the variety of problems studied, and the results given are somewhat fragmentary. A fuller discussion of a few topics, including more explanation, might perhaps have been clearer.

In the Venereal Diseases enquiry the answer "know all about them" should not be interpreted literally. It means that the informant was familiar with the idea of V.D. and not consciously in a state of mystification about the subject. The colloquialism may be ambiguous, and the sample is not, as Dr. George suggests, biased in favour of Harley Street specialists.

Another point made by Dr. George was that men gave more answers than women to the questions about canteens. It is quite frequently found in opinion surveys that men give more answers. The experience of interviewers does not bear out that women are "more impatient." It may be that men are better able to express their opinions, or that they have more ideas. A similar tendency to give a number of answers is shown by the higher income groups and those with higher education.

The discrepancies in the sample figures pointed out by Dr. George are due to omissions on the part of the interviewers. These omissions are in the nature of clerical errors and do not reflect any reluctance on the part of informants to divulge their sex, age or economic group. (The footnote in the section on M.O.I. publications should have been given earlier to include these tables.) However, in the table showing the proportions of those who had read the V.D. statement saying they had known about V.D. before, the figure 1,897 for the lower economic group is an error. This should be 1,497, and the correction will answer Dr. George's question as to where they all come from.

Professor Greenwood criticizes opinion questions. Among these, questions about motives are often difficult to cope with, but not all opinion questions are about motives. Many of them are very straightforward. Professor Greenwood suggests that informants may invent answers when the real answer does not seem to them to be a good one. There is, of course, no absolute evidence that this does not sometimes happen, but it is difficult for people who are not themselves interviewers to believe how very candid people are about most subjects. The fact that the interviewer is a stranger, and not connected with the informant's group of acquaintances, very often has the effect of opening the flood-gates. The informant knows that he is anonymous, and is generally glad of the opportunity to speak freely. In fact, it is more than likely that the canteen bore, had he existed, would have found his way on to the recording schedule. In the majority of opinion questions asked by the Survey there is no reason why the informant should not give a truthful answer, since he has nothing to gain by doing otherwise.

Professor Greenwood thought that the Survey should confine itself to matters of fact and leave matters of opinion alone. To do this would be to throw overboard one of the Survey's most useful functions. Factual information by itself may even be misleading. It may be known that x per cent. of the housewives who tried to buy kettles succeeded in getting them, and this may suggest that the kettle situation is satisfactory. However, on asking housewives' opinions about the kettles they bought, we may find that nearly all of them were dissatisfied, and reach the opposite conclusion. Similarly, in housing problems it is of importance to know what people think about the changes it is proposed to make and to take their wishes into account. The Survey's methods are particularly well suited to get this sort of information.

Mr. Goldmann pointed out the necessity of checking the composition of samples against known information. The Survey makes a point of doing this, and questions (e.g., whether married, single or widowed) are included in recording schedules for this purpose.

Results are frequently analysed by interviewers to detect bias from this source. This is always done when a question with much danger of bias is asked.

Mr. Reddaway spoke of the unreliability of memory, and this is one of the most serious problems that social surveys of this sort have to contend with.

It seems that with an enquiry into a subject like crockery breakages the most accurate results would be obtained by persuading a representative sample of housewives to keep written records, and collecting them periodically. However, there would be many practical difficulties to overcome if this were done, and too many enquiries carried out in this way might cause overburdened housewives to follow the example of the farmer in Dr. Bradford Hill's story. There may be other ways of solving this memory problem, and in course of time they will probably be discovered.

Mr. Madge raised the point of classifying informants by economic group. The method used at present is satisfactory when only a rough comparison is needed, but, as Mr. Madge says, more refined methods would have to be found if the Survey were called upon to investigate more specifically economic problems than it has tackled so far.

Mr. Ferraby's argument about there being less need for an accurate technique in some problems than in others is rather obscure. The Survey takes the point of view that reliable results can be obtained only if the sample chosen is representative of the parent population, and this seems to hold good whether the subject of the enquiry is simple or complicated. Qualitative information about attitudes can be of use only if the proportions of the population having different broadly defined attitudes are known, and for this reason statistical treatment is the first essential. Further probing of the attitudes of individuals is no doubt of very great value in supplementing statistics and in suggesting lines for further enquiry.

Dr. Rutland criticized the Survey's method of economic classification on the grounds that this was not objective. The difficulty arises only when the wage-rate is indefinite or when income varies from week to week, as for instance with shopkeepers. In the majority of cases there is no difficulty in classifying informants on an objective basis. The wage-rate or occupation method seems preferable to a classification based on a number of variables of which the interviewer has to decide which is the operating one. Before the war research workers frequently classified families into social groups according to the type of house in which they lived. This would clearly be very misleading in war-time. The present method seems to be less open to bias than others that have been suggested. This and similar problems can be solved only by a series of experiments such as the Survey hopes to have the opportunity of carrying out in the future.

As a result of the ballot taken during the meeting, the candidates named below were elected Fellows of the Society:—

Ely Devons.
Herbert Weston Haycocks.
Harold Kenney, M.A.
John William Matthews.
Maxine Patricia Mary Merrington.
Joan Eileen Mitchell.

Robert William Pomeroy, M.A.
William Brian Reddaway.
John Thomas Richardson.
Elizabeth M. Taylor.
Cecil James Traill-Hill.
Konrad Zweig.

Corporate representative

Josef Ehrlich, A.Mech.I.E.E., *representing the Czechoslovak Ministry of the Interior Department of Education.*

METHODS OF LISTENER RESEARCH EMPLOYED BY THE BRITISH BROADCASTING CORPORATION

By R. J. E. SILVEY

[Read before the ROYAL STATISTICAL SOCIETY, June 20th, 1944, the PRESIDENT, DR. E. C. SNOW, C.B.E., in the Chair.]

SOME years ago Mr. W. A. Robson published an essay on the British Broadcasting Corporation in a volume entitled *Public Enterprise* (George Allen and Unwin, London). Discussing the relations between the B.B.C. and the public, he wrote:

"The B.B.C. has only the vaguest and most remote contact with the world of listeners. It does not really know who they are, to what they listen, or what their views are. Its channels of communication are limited entirely to the press on one hand, to the active letter-writing correspondents on the other. The press is of little use for this purpose . . . chiefly because it is not in any closer touch with the listener than is the B.B.C. itself. The letter-box as at present used is also an unsatisfactory instrument of contact. Most people do not write letters unasked in order to express their opinions to unknown officials; those who do write are seldom typical. 'Fan-mail,' when it does occur, is notoriously untrustworthy."

Mr. Robson's statement was true of the early years of the B.B.C. It is no longer true today. On October 1st, 1936, a few months, in fact, before his essay appeared, the Corporation had set up a department to undertake "listener research" for its home programmes.*

The department had first to explore demand within the B.B.C., to find out what kind of information was needed most, and then to arrange these demands in an order of priority. It had then to find out, where necessary after experiment, the best means of meeting these demands. It was the department's responsibility to set up and operate any permanent machinery found necessary, and to ensure that the results of its enquiries were effectively brought to the notice of all concerned.

It is not proposed in this paper to trace the early development of listener research. The pre-war years were, in fact, years of experiment. By the end of 1941 the department's organization had taken its present shape, which is unlikely to change so long as present conditions continue. The following paragraphs describe the machinery of listener research as it exists today and give some examples of its findings.

There is a wide range of needs for listener research within the B.B.C. An adequate service must build up, and keep up to date, a corpus of information on the basic tastes and habits of the listening public. It must also provide a number of continuous services. These services involve the estimation, with as much accuracy as possible within reasonable financial limits, of

(a) the quantity of listening to each broadcast;

(b) the degree of popularity of individual programmes among those who hear them, and the causes of such popularity—or lack of it;

* The whole of this paper deals with listener research among the audience within Great Britain. Studies of the audience to the various B.B.C. overseas services do not fall within the province of the Listener Research Department.

(c) the reactions of the public to the B.B.C.'s policies and changes of policy;

(d) the state of public opinion on matters with which the B.B.C. is concerned.

Experience has shown that these needs can be met by three permanent and parallel systems of gathering information, supplemented from time to time by *ad hoc* studies. Briefly, the three systems, which will be described later in detail, are:

(1) *A Survey of Listening*: a continuous sample enquiry, carried out by personal interviewing, primarily to measure the extent to which programmes are listened to, but secondarily to allow quantitative studies of the entire listening public to be made.

(2) *Listening Panels*: each consisting of a number of listeners with a common interest in a particular type of programme. The primary function of Listening Panels is to provide a means for gauging the impact of individual programmes upon their listeners.

(3) *Local Correspondents*: persons who report the opinions of friends and acquaintances on questions of importance to the B.B.C. They are used as sounding-boards of public opinion, particularly on general questions of broadcasting policy which are likely to have been the subject of common discussion. Correspondents in H.M. Forces are known as Forces Correspondents.

These three systems form a flexible organization which often allows a problem to be simultaneously approached from more than one direction.

THE SURVEY OF LISTENING

An inevitable disability under which every broadcasting organization labours is the lack of what may be described as an "organic contact" with its public. The B.B.C. has no daily sales figures, no "box office" which might provide hard evidence of the reactions of the public to its services. Curves of electricity-power consumption are of little use for this purpose, for they only reflect the incidence of listening to the exceptional broadcast. Load-meter readings compiled by Radio Relay Companies might be more useful, but they are not continuously kept, and, in any case, can only record the listening of persons whose choice of programme is limited to those which the companies offer.

The only practicable method of obtaining a continuous measurement of listening is from the public itself, by means of some form of sample enquiry. The Survey of Listening was set up primarily for this purpose in December 1939 and has continued, with no fundamental change in method, ever since. A sample, designed to represent the civilian population of Great Britain over the age of 16, is interviewed each day. At each interview a written record is made of the programmes, if any, which the subject (or "contact") listened to the previous day and of his answers to certain supplementary questions.

The Sample

The daily sample consists of 800 interviews, though to allow for wastage from unavoidable causes, about 850 interviews are commissioned. Interview-

ing is spare-time paid work. Interviewers are recruited by personal recommendation, or from among persons who have previously given reliable voluntary service to listener research. After training, they become members of a Pool, now about 450 strong. Every Monday morning some 20 interviewers from this Pool begin assignments of 21 days' work, so that at any one moment about 60 interviewers are actively engaged. The average number of interviews per diem, made by each interviewer, is thus about 14.

Interviewers work in their own districts, so that extensive travelling is rarely necessary. They are appointed on a plan which provides representation in every day's sample of each of the six Regions into which the B.B.C. divides Great Britain in proportion to their population. Within each region there is a further subdivision, to ensure the representation, in proportion to population, of rural areas, and of urban areas of differing sizes. (It has not been found practicable in war-time to include Northern Ireland.)

Interviewers are given details of the types of person of which their daily quotas of interviews must consist. These are under four heads: sex, age (16-19, 20-29, 30-49, 50 and over), social class (upper-middle, lower-middle, and working class), and "habits" (whether or not normally at work in the daytime). Within these quotas interviewers may interview whom they like, though they are forbidden to interview the same person more than once in three months.

The number of contacts of each type which they are required to make is determined by an overriding plan for the sample as a whole. This plan, which is subject to periodic revision, aims at a distribution in the sample which will correspond to that in the population under investigation. Estimates of the distribution of the population in terms of the four characteristics given above are based upon the latest available data. Under present conditions some of these estimates cannot be made public, but the distribution by social class presents special problems which deserve mention.

Without attempting a definition of "social class," it is clear that the differing standards of living, culture and education existing in the population have relevance to a survey of listening. Subtle gradations in a large number of groups would serve no useful purpose, and in any case could not be put into effect in day-to-day fieldwork. But it is necessary to ensure that three broad, and comparatively easily recognizable, social classes are distinguished and given proportionate representation—namely, the upper-middle, lower-middle and working classes. Mitchell and Harrison in *The Home Market* (George Allen and Unwin, 1938) estimated the strength of these three classes to be in the proportions of 5 : 21 : 74, and this estimate is used for the Survey of Listening.

Interviewers are instructed to classify as upper-middle class the members of households of which the head might be expected to have had an income, before the war, in excess of £10 per week. Members of households of which the head might have been expected to have a pre-war income of £4 to £10 a week are classified as lower-middle class. The remainder are classified as working class.

In practice, interviewers do not put direct questions to arrive at these classifications, nor is there need for them to do so. They are required to ask the contact's occupation, and this, together with a common-sense assessment of the contact's manner, bearing and conversation, serve well enough for the purpose.

The results of studies, in terms of social class, of the data collected invariably follow patterns which give good evidence that the system, if crude, does in practice work well.

The Interview

The interviewer approaches his task of making contact with a prescribed number of persons of differing types armed with a handbook of instructions on which his training was based and to which he can refer when in difficulties. The essence of the interview is the recording of the programmes which the contact heard. Naturally, the narrower the gap between the broadcast and the moment of recall, the less will be the danger of error arising from faulty memory, but experience shows that, sufficiently guided, people can recall without difficulty their previous day's listening behaviour. A longer interval would introduce much inaccuracy and would militate seriously against less memorable programmes. No results are, therefore, admitted which were not collected on the day following the broadcasts.

Interviews are recorded on printed log sheets which give all the previous day's broadcasts, and which are used to aid the contact's memory in recalling the programmes which he has heard.

The interview, which may take place anywhere—on the doorstep, in the street, in the factory canteen or shopping queue—will probably begin by the interviewer explaining that he is assisting in a Survey of Listening for the B.B.C., and will be grateful if he could put a few questions. (The average interview takes five or ten minutes to complete.) Rebuffs are comparatively rare, indeed the goodwill created by the Survey, which the man in the street recognizes as evidence of the B.B.C.'s concern about him, has been a by-product of considerable value. The interviewer will then explain that he wants to know to which of the previous day's programmes the contact listened. The reply may be "None," but the wise interviewer will make sure that the contact has not forgotten the News, for it is not uncommon for people to think that an enquiry about "listening" does not include News Bulletins. If the contact did not listen at all, if, indeed, he does not possess a wireless receiver, he is not excluded from the interviewer's quota, for the Survey is a study of the listening behaviour not merely of "listeners," but of the whole adult civilian population.

If the contact did listen, the interviewer endeavours, by a process of association and aided recall, to get him to remember the programmes he heard. The contact is encouraged to pass his mind over the previous day's events—rising, having breakfast, leaving for work, returning, and so on. By this means his effort of recollection is made easier, especially as the interviewer can remind him of the programmes broadcast at times when he was free to listen. The interviewer will be careful not to convey the impression that there is anything reprehensible about not listening, or about listening to one broadcast rather than another. He achieves this positively rather than negatively, by laying the emphasis on the effort of accurate recollection rather than by verbal reassurances. In a word, the interviewer bends all his efforts towards extracting from the contact an accurate account of his listening behaviour. This calls for considerable tact and skill. At times the interviewer will have to decide whether or not to record as "listening" the contact's account of his behaviour. Remarks such as "I had the wireless on, but I can't say I was really listening," "Somebody called in the middle," "I only heard the headlines," or "I just

came in for the end " are familiar. The interviewer's handbook of instructions forearms him against the great majority of such situations. It contains, for example, a paragraph headed " What to do with contacts who listen with half an ear " and reads :

" Many people choose to listen while they are shaving, knitting, or doing housework, for instance, so it would certainly be quite wrong only to count people as having listened to a programme if they gave their full and undivided attention to it. On the other hand, a certain minimum of attention is necessary before we can regard a person as having listened to a programme. What the minimum should be depends on the type of programme. For instance, you do not need as much concentration to listen to a cinema organ as you do to a talk. You will have to use your common sense in deciding what to do in individual cases. But the following will help you—

If your contact says his wireless set was on at a certain time, but even after you have told him what programmes were being broadcast on the Home Service and Forces Programme at that time, he hasn't the vaguest recollection of these programmes, then *don't* count him as having been a listener at that particular time."

Clearly, this is not the only view of listening which could be taken. A more austere or a looser standard could be prescribed. But more important than the standard itself is the consistency of its application, week in week out, by all the interviewers.

Supplementary Questions

Experience has shown that interviewing is appreciably assisted if the interviewer is required to ask questions concerning other things besides the previous day's listening. Two such questions are, therefore, put at every interview; one variable, the other constant. The former may concern any aspect of broadcasting, provided that it can be posed in simple terms and answered, without prolonged cogitation, in more or less black and white terms. The fact that the interview is normally between strangers, and generally comes as a surprise to the contact, imposes limitations on the kind of question which can be asked. This variable supplementary question is, however, of special value when the number of those giving different replies is of particular importance, or where it is desirable to measure the difference between the answers of one kind of listener and another. For example, an enquiry about favourite radio stars could be suitably made through this means. The question would be posed in some such words as these: " Which, if any, of the following radio stars do you make a point of listening to if you can? ", and would be put to all who have regular access to a wireless receiver. The question would be asked each day for, say, a week—*i.e.*, of some 5,000 persons: a sample large enough for subdivision by sex, age, social class, or region. But the most important use to which this form of enquiry is put is the measurement of the basic tastes of the listening public. The procedure and some of the results obtained from this procedure will be dealt with later.

The constant question is a simple one: " On the whole are you satisfied or dissatisfied with present B.B.C. programmes? " The answers are classified as

"completely satisfied," "moderately satisfied," "thoroughly dissatisfied," "undecided or no opinion," and a record is made of contacts' supplementary comment, if any. This question, which is not asked of contacts who do not normally have regular access to a wireless set, is included as much for the benefit of the interview as for the information it yields. In fact, the distribution of answers has proved over a long period to be astonishingly inelastic.* Supplementary comment tends to be highly repetitive and rarely illuminating. The great merit of the question is that it gives the listener an opportunity to "let off steam."

Veracity

It may well be asked whether steps are taken to ensure that interviewing work is done conscientiously, or even done at all, or to guard against the danger of a dishonest interviewer completing his assignment by drawing upon his imagination in the comfort of his own fireside. Such dangers do exist, and can never be wholly excluded. There is reason to believe, however, that they are more hypothetical than real. Interviewers are carefully chosen and are, from time to time, personally seen by the organizing staff. Although the work is paid, its character, as intermittent part-time work, is such that it offers no particular inducement to the professional trickster. Indeed, to a very large extent those who undertake interviewing are actuated by interest in the work and by a sense of public service. The results of all interviewers' work are the subject of close scrutiny at headquarters, and one whose interest in his task is slight, or diminishing, and who might on that account more easily give way to the temptation to fake his results, is likely soon to reveal himself by slipshod work. The interviewer who constantly turns in results which differ radically from those of others is naturally the subject of immediate suspicion, as is also the interviewer whose results are "too perfect." After four years' experience, it is believed that undetected dishonest work is so rare that it can have little or no effect upon the total result.

Tabulation

Once a day's interviews have been made, it is of great importance that the tabulation should take as little time as possible, a punch-card system and mechanical sorting are, therefore, employed.

The results give a daily document known as the "Listening Barometer," which is available about seven days after the broadcasts have taken place. It shows for each broadcast the percentage of the sample recorded as having listened. It bears a note which reads: "Subject to the limitations of sampling, the figures below show the percentage of the whole adult civilian population of Great Britain who listened to each item." (Notes on the probable error in the figures are issued from time to time.)

These "barometer figures" are also made the subject of a weekly commentary and of frequent *ad hoc* studies. All these are circulated among senior officials and are available to all members of the staff to whom they may be of value.

* On more than 80 per cent. of the 246 days between March 11th and October 31st, 1943, the percentage of listeners giving the reply "completely satisfied" lay between 45 per cent. and 55 per cent., and the percentage replying "moderately satisfied" between 30 per cent. and 40 per cent. The reply "thoroughly dissatisfied" exceeded 4 per cent. on only 27 days and never reached 7 per cent.

Results—(a) Listening Behaviour

Table I * has been designed to show, in a condensed form, the quantity of listening to some of the more well-known series of programmes as estimated by the Survey. The table covers the seven-months period March/September 1943 for News Bulletins, and for other types of output the nine-months period January/September 1943. It shows, for each series of programmes, the limits which embrace 50 per cent., and 80 per cent. and all of the cases falling within the period under review.

As might be expected, News Bulletins command the biggest listening audiences, with the 9.00 p.m. the most listened to of all. It is normal for half the adult civilian population to listen to at least some of this bulletin, though the figure approaches 70 per cent. when the Prime Minister speaks. The pattern of News Bulletin listening on Saturdays differs somewhat from that of Monday to Friday; thus, the Saturday 1.00 p.m. bulletin normally has rather larger audiences, and the 6.00 and 9.00 p.m. bulletins rather smaller. Midnight News Bulletin listening is much more common on Saturdays than on other days, and this has its reflection in the relatively low 7.00 a.m. News Bulletin listening on Sundays. The Sunday 1.00 p.m. News Bulletin commands very large audiences, rivalling that of the 9.00 p.m. News, while Midnight News listening on Sundays is lower than on other days.

During the period under review no spoken-word programme, indeed few programmes of any type, commanded such consistently large audiences as the Sunday Night Postscript. Half the listening figures recorded fell between 29.1 per cent. and 32.4 per cent. The Sunday Night Postscript, besides occupying an enviable position immediately after the 9 o'clock News, had the advantage of being simultaneously broadcast in both the Home Service and the Forces Programme, so that it did not have to share the available audience with any other B.B.C. home transmission. Its runners-up among spoken-word programmes were the Brains Trust and War Commentary, with audiences which tended to fluctuate around 20 per cent. Other spoken-word series had smaller audiences, but it should be borne in mind that many factors besides the intrinsic popularity of a series play an important part in determining the size of an audience. Chief among these is the series' timing. 8.00-9.30 p.m. are the peak hours, and no weekday programme placed outside this period can expect to command the audience it would secure if it fell within that coveted time zone.

Competition is also a potent factor. In war-time Britain there are only two medium-wave B.B.C. transmissions for home consumption. A strong attraction in one service will therefore tend to draw listeners away from the programme simultaneously broadcast in the other transmission. A broadcast series' audience is also affected by that of its near neighbours. Place a series after a popular item, and its audience will benefit by a "carry over." It may even benefit by being placed before a popular broadcast, for it is evident that many listeners switch on their sets before their favourite is due to begin, so as to be sure that they miss none of it.

In radio drama the two series which have proved to have the widest appeal are Saturday Night Theatre, which frequently consists of popular stage successes adapted for broadcasting, and "Marching On," a programme in which items

* The numbered tables will be found following the memorandum.

from the week's news are presented in dramatic form. Except for a limited number of serial plays, each radio play is complete in itself, and it is therefore natural that their audiences should vary considerably, even when they have a common timing. Thus, twenty-seven Sunday afternoon plays during the period had audiences which varied between 3 per cent. and 14.3 per cent. Similarly, feature (documentary) programmes placed between 8.00 and 9.00 p.m. had audiences fluctuating between 4 per cent. and 16.2 per cent.

Serious music, of course, commands relatively small audiences, though the smallest audience for a broadcast concert exceeds by many times the capacity of any public hall. The appeal of light music is exemplified by the audience for "Grand Hotel" (Sundays, 8.20 Forces Programme), and that of dance music by the B.B.C. Dancing Club (Wednesdays, 7.30 or 8.00 p.m., Forces Programme). Both of these programmes had audiences which reached a maximum of 27.9 per cent.

In the religious field, the Daily Service, broadcast at 10.15 a.m. on week-days, is something of a broadcasting institution. It falls at a time when a very substantial proportion of the listening public is at work; nevertheless it has a faithful following. Four-fifths of the 234 broadcasts falling within the period under review had audiences of between 5 per cent. and 7.3 per cent.

It is under the heading of light entertainment that most of the series of mass appeal are to be found, the maximum and minimum audiences for most of the well-known series during the period under review being:

	Minimum, %	Maximum, %
Happidrome, Sundays, 7.10 p.m., Forces Programme	28.5	44.1
Monday Night at Eight, Mondays, 8.00 p.m., Home Service	27.1	40.6
The Old Town Hall, Tuesdays, 7.45 p.m., Forces Programme	20.3	31.3
Itma, Thursdays, 8.30 p.m., Home Service	21.7	33.8
Music Hall, Saturdays, 8.00 p.m., Forces Programme	25.5	41.3

The following list covers a range of the more important individual broadcasts during 1943, and shows the percentage of the samples which were recorded as having listened to them:

FEBRUARY.						%
"War and Peace," final broadcast	Sun.	7th	Home Service	9.30 p.m.	15.2	
Albert Hall, Red Army Ceremony	,,	21st	Forces	4.15 p.m.	27.2	
MARCH.						
Feature Prog.: "The Building of an Army"						
Part I	Mon.	1st	Home & Forces	8.30 p.m.	28.8	
Part II	Wed.	3rd	" "	" "	21.8	
Part III	Fri.	5th	" "	" "	30.7	
Tribute to China Concert						
Part I	Sun.	22nd	Home Service	3.00 p.m.	8.0	
Part II	"	"	" "	4.00 p.m.	5.6	
"Messiah"	Sun.	28th	Home Service	11.45 a.m.	15.2	
Part I	"	"	" "	2.30 p.m.	16.2	
Part II	"	"	" "	3.50 p.m.	15.2	
APRIL.						
Talk: "25 Years of the R.A.F."	Thur.	1st	Home & Forces	9.20 p.m.	41.1	
H.M. The Queen	Sun.	11th	Home & Forces	9.00 p.m.	66.5	
"The Man Born to be King," final broadcast	Sun.	25th	Home Service	9.35 p.m.	14.5	

MAY.

Play: "The Great Ship," by	Sun. 9th	Home Service	3.30 p.m.	%
Eric Linklater (1st repeat)	Wed. 12th	" "	9.40 p.m.	11.3
(2nd repeat)	Fri. 14th	" "	8.00 p.m.	14.9
				12.9

JUNE.

Running Commentary on the Derby	Sat. 19th	Forces	1.15 p.m.	32.1
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AUGUST.

"Peer Gynt" Part I	Mon. 9th	Home Service	7.30 p.m.	12.0
Part II	" "	" "	9.40 p.m.	11.1
Last Promenade Concert of the Season Part I	Sat. 21st	Home Service	7.00 p.m.	6.2
Part II	" "	" "	8.30 p.m.	6.7

SEPTEMBER.

Gracie Fields	Thur. 2nd	Forces	8.00 p.m.	27.0
Feature Prog.: "The Battle of Britain"	Wed. 22nd	Home Service	9.45 p.m.	17.2

OCTOBER.

Talk: Sir William Beveridge on "Can Unemployment be Prevented?"	Mon. 11th	Home Service	7.35 p.m.	13.3
Beethoven Mass in D Part I	Wed. 13th	Home Service	7.20 p.m.	9.0
Part II	" "	" "	8.25 p.m.	7.0

NOVEMBER.

Feature Prog.: "The Red Army"	Mon. 8th	Home Service	7.30 p.m.	22.0
Feature Prog.: "21 Years of the B.B.C."	Sun. 14th	Home Service	9.20 p.m.	21.6
Poetic Drama: "The Rescue" Part I	Thur. 25th	Home Service	9.40 p.m.	10.5
Part II	Fri. 26th	" "	9.35 p.m.	8.7

DECEMBER.

Feature Prog.: "We are Advancing"	Christmas Day	Home & Forces	2.00 p.m.	43.7
H.M. The King	" "	" "	3.00 p.m.	64.2

(b) *Listeners' Tastes*

Reference was made earlier to the measurement of the basic tastes of the listening public by means of questions put by interviewers as supplementary to the "logging" of programmes heard. Types of broadcast output are dealt with one at a time, and each is normally made the subject of enquiry for at least a week. Interviewers will, for example, be told that the "type for the week" is Plays. Having logged the programmes heard, they will invite each contact (excluding only those who have no normal access to a wireless set) to express his views on broadcast plays. On the basis of his reply the interviewer then records the contact as falling into one of five groups. If the contact's reply clearly shows that broadcast plays mean a great deal to him, that he takes every possible opportunity of hearing them—if, in a word, he is an enthusiast—he is assigned to Group A. The contact who, though he displays an interest in plays, is not so enthusiastic as to be classified as A, is placed in Group B. Group C embraces those who have a neutral attitude, such as the contact who would listen to a play only "if he had nothing better to do," or, though he would not necessarily switch off, or re-tune, his set when a play was announced, would rarely make an effort to hear one. In Group D would be

placed those who dislike, and, if they can, avoid hearing, broadcast plays, but whose distaste could not be described as violent; those whose hostility to plays is very marked would be placed in Group E.

The circumstances under which these enquiries are carried out provide opportunities for some degree of verification. Apart from the fact that the results from different interviewers and from each day's work can be compared, the grading of contacts can be correlated with their listening behaviour on the day before they were questioned. It is invariably found that there is a high positive correlation between their grading and the extent to which they have listened to programmes of the type under discussion.

The main types of programme are the subject of this form of enquiry about once a year, and Table II gives the most recent results for sixteen well-known types. Variety is easily the most popular, nearly half the listening public being classifiable as enthusiasts (Group A), while A and B Groups together include nearly 75 per cent. Those who dislike Variety amount to only 13 per cent. There are seven other types of output where the A and B Groups together exceed 50 per cent.: Plays, Musical Comedies, Military Bands, Cinema Organs, Feature (documentary) Programmes, Brass Bands, and Religious Services. The A and B Groups cover less than 20 per cent. for only two types: Poetry Readings and Chamber Music.

Table III shows the changes which have taken place in the listening public's attitude towards these sixteen types of programme. Five types have shown an unbroken increase in popularity if this is measured by the sum of the A and B Groups over three enquiries.

					A + B Groups		
					Enquiry I, %	Enquiry II, %	Enquiry III, %
Plays	...	...	...	...	47	55	56
Feature (documentary) Programmes	...	...	...	...	41	44	60
Religious Services	...	...	...	...	41	47	52
Grand Opera	...	...	...	...	25	26	29
Symphony Concerts	...	...	...	...	23	25	26

Only one type, Dance Music, has shown a steady decline in popularity, with a corresponding increase in unpopularity.

					Enquiry I, %	Enquiry II, %	Enquiry III, %
A + B Groups	...	...	...	...	53	47	41
D + E Groups	...	...	...	...	25	29	35

In five cases the second enquiry revealed a substantial decline in popularity which was subsequently recovered in whole or in part.

					A + B Groups		
					Enquiry I, %	Enquiry II, %	Enquiry III, %
Variety	...	...	...	...	79	68	73
Musical Comedies	...	...	...	...	54	51	63
Cinema Organs	...	...	...	...	60	50	58
Discussions	...	...	...	...	49	38	41
Talks	...	...	...	...	47	41	45

The popularity of a given type of programme may fluctuate not because of any change in the basic tastes of listeners, but because of a variation in the

quantity or quality of the programmes broadcast. Alternatively, changes in the public mood may result in varying the popularity of programmes of constant quality. As the relative strength of the various operative factors is impossible to estimate with any certainty, the causes of a change in the popularity of a given type of programme must remain a matter of speculation. Taking a broad view, however, Table III is more notable for showing the inelasticity of the public's attitude than its capriciousness. None of the fluctuations which it reveals are of such a magnitude as to indicate any revolution in attitude over three years.

The size of the samples employed in each enquiry make possible analyses in terms of social class, sex and age. Table IV gives an extract of such analyses for sixteen types of output. Five of the fourteen types are more popular with working-class than with lower-middle-class listeners, and more popular with lower-middle, than with upper-middle-class listeners. These are Variety, Musical Comedies, Cinema Organs, Military Bands, and Dance Music. Of these, only Variety is equally popular with men and women. Military Bands are more popular with men than with women, whereas the three other types, Musical Comedies, Cinema Organs and Dance Music, are more popular with women than with men. Variety, Musical Comedies, Cinema Organs and, above all, Dance Music become decreasingly popular with each step up the age scale. Brass Bands, like Military Bands, are much more popular with men than with women, but, unlike Military Bands, they are much more popular with listeners over thirty, than with younger people.

The other ten types are more popular with upper-middle than with lower-middle-class listeners, and more popular with listeners in the lower-middle class than with those in the working class. Enthusiasm for Plays and Feature (documentary) Programmes, closely allied types, does not appear to be related to the age of the listener, but whereas Plays appeal more to women than to men, Features appeal more to men than to women. Talks and Discussions both appeal more to men than to women, whereas the reverse is true of Religious Services. But all three are progressively more popular with each step up the age scale.

None of the other five, Grand Opera, Symphony Concerts, Chamber Music, Short Story Readings and Poetry Readings, appeal so much to the under twenties as to maturer listeners. Grand Opera, Short Stories and Poetry Readings all appeal more to women than to men; Symphony Concerts and Chamber Music find relatively more support among men than among women.

It would be unfortunate if the relatively extensive treatment which this type of enquiry has received in the foregoing paragraphs should lead to any misunderstanding of its place in listener research. It is a by-product of the operation of the Survey of Listening, and it contributes valuable additions to the stock of basic information about the listening public, but the information which it yields has definite limitations, which have constantly to be borne in mind. Its validity, for example, depends on the extent to which there is common agreement on the meaning of the various categories of programmes. Whereas there is, for example, likely to be little disagreement upon what is meant by the term "poetry readings," the term "feature programmes" is known to be far less familiar. The obvious remedy—to allow interviewers to supplement the use of a term by quoting as examples the names of well-known broadcasts—is open to the serious objection that once a specific broadcast is

named, the contact is only too liable to give a reply which is biased by his attitude towards the particular example which has been quoted to him.

It should not be necessary to point out, moreover, that a range of enquiries on attitudes towards different types of programme output does not throw light on what relative quantities of those types the public wants. Because 43 per cent. of the public are variety enthusiasts and 6 per cent. are enthusiasts for chamber music, it does not follow that if the programme time devoted to variety and chamber music was in the ratio 43 : 6, this would give the greatest satisfaction to the greatest number.

To sum up, it will thus be seen that the Survey of Listening provides, so far as adult civilian listeners are concerned, the first of the four continuous services required—a means of estimating the *quantity* of listening to each broadcast.* At the same time it provides, through the supplementary questions, one method by which, subject to limitations, the reactions of the public to B.B.C. policies can be ascertained, or the state of public opinion gauged. It also provides, both directly and indirectly, much material about listeners' habits and tastes.

LISTENING PANELS

The size of the audience is, however, only one aspect; quite another is the extent to which the broadcast was enjoyed. The relationship between these two is highly variable. Two broadcasts may have equal audiences, but one may make an infinitely greater impression than the other. If the success of a broadcast is to be measured, it is, therefore, necessary to take both these aspects into account.

This double approach is particularly important for the B.B.C., because it has always recognized the need to regard its audience not as one single listening public, but as a series of listening publics for different types of output. There is a public for radio drama, another public for broadcast dance music, another for religious services, and so on. These publics may, and do, overlap, but for certain purposes they are rightly considered as separate. Once the demand for a particular type of output is agreed to warrant its inclusion in the programme schedule, and the programme time and money to be allocated to it have been decided, the size of the public for it is immaterial. It becomes the duty of those responsible for filling that time to provide the best material that can be obtained. Those producing programmes—particularly "minority" programmes—are rightly concerned to see that such programmes are enjoyed by their respective publics, no matter what size that public may be.

Organization

The system of Listening Panels has been devised, therefore, to provide a means of estimating the extent to which broadcasts please those who choose to hear them, and of locating the causes of success or failure.

Five Listening Panels have been set up: A Music Panel, a Plays Panel, a Feature Programmes Panel, a Talks and Discussions Panel, and a Light Entertainment Panel. The last has a membership of 1,000, each of the others has

* No continuous estimates of the child audience to Children's Hour or School broadcasts are made. *Ad hoc* studies of children's tastes are made, and there is a specialist staff of Education Officers who are concerned with the "listening end" of schools broadcasts.

600. Panel membership is honorary. From time to time the B.B.C. publicizes this work and invites the participation of listeners.* Volunteers always exceed requirements, and panels are built up by selection from these volunteers. As far as possible, volunteers are assigned to the panels of their own choosing, though the primary aim is to make each panel correspond, in terms of sex, age, region and social class, to the listening public for the type of programme with which it is concerned—as ascertained by the Survey supplementary-question technique already described.

Every Saturday each panel member receives questionnaires relating to three programmes to be broadcast in the ensuing week. He is asked to complete the questionnaires for such of these broadcasts as he would in any case be listening to, and to return them promptly. Particular stress is laid upon the undesirability of "duty listening"—that is, of listening to and reporting upon a programme solely because a questionnaire has been issued. It is pointed out to panel members that if they duty-listen, they are running counter to the purpose of the scheme, which is to obtain a picture of the reactions to a programme of those who, exercising their free choice, choose to listen to it.

The proportion of questionnaires returned is, therefore, largely governed by the listening habits of panel members. If the questionnaire concerns a broadcast at a reasonably good listening time—and most questionnaires do—a return of one-third is regarded as satisfactory. As it is not regarded as satisfactory to base a report upon less than 200 completed questionnaires, it is this normal rate of returns which fixes the "established strength" of panels.

There is no fixed term of office for a panel member. He continues to be a member until either he resigns or his rate of return falls below a statutory minimum. In practice, the average life is 18 months to 2 years, and there is no evidence that continued membership alters the character of answers in such a way as to render them decreasingly representative.

Questionnaires

The questionnaire is short; it rarely exceeds eight questions and usually less. Questions are of three types. First come questions to obtain listeners' views on different aspects of the broadcast. A questionnaire about a play will include separate questions about the quality of the acting, of the production, and of the script. A questionnaire about a concert will include questions about the choice of works played and the quality of the performance by the orchestra and soloists. In drafting such questions, which is done in consultation with the producer, care is taken to avoid the use of technical terms. Leading questions are, of course, barred, as are questions which, if they were to be answered adequately, would require any degree of broadcasting expertise. In a word, the purpose of these questions is limited to the drawing out from the listener his opinion on things which are within his listening experience.

In most cases alternative answers are provided, but space is given for the addition of comment. This method has two advantages. It simplifies the process of analysis, and it corrects the bias which would otherwise operate in favour of the more articulate panel members.

* A typical appeal in the *Radio Times* in December 1942 produced 2,800 enquiries of which 2,250 subsequently proved to be firm offers of voluntary help. 600 of these were accepted for immediate vacancies, the remainder joining the Reserve.

After these questions come two standard features of all questionnaires. The first is a space for "any other comments." This allows the panel member to enlarge upon any view which he feels is either inadequately brought out, or not covered at all, by his answers to earlier questions. The second is an invitation to award marks to the broadcast (out of ten). Panel members are told in their initial instructions that this marking is intended to give them an opportunity to rate their enjoyment or appreciation of the broadcast as a whole. If they consider it to have been so enjoyable, or so interesting, that they do not expect ever to hear a better broadcast of a similar type, they should award it ten marks. If they derived no enjoyment or interest from it whatever, it should be marked nought. In any case, the marks should reflect their own subjective experience in relation to their own personal scale of values. The average of the marks awarded to a broadcast, multiplied by ten, is known as the Appreciation Index.*

From the completed questionnaires reports are prepared in some detail. They include a note on the size of the audience, derived from the Survey of Listening, and against this is set the Appreciation Index. Both these figures will then be compared with those of like programmes similarly placed. Then follows a summary of the answers to the questions, in which an attempt is made to pinpoint the causes of the broadcast's success or failure with those who heard it. Fifteen such reports are prepared weekly—a number which it is hoped will be increased when normal conditions return.

Representativeness

Earlier in this paper it was claimed that "the system of Listening Panels provided a means of estimating the extent to which broadcasts please those

* The device of calculating Appreciation Index numbers has the obvious advantage of facilitating a comparison of the success of different broadcasts. It is not certain, however, that the 0/10 marking system is the best that could be devised. In practice it is found that there is a noticeable tendency for the mark 7 to be used by panel members to denote the mediocre and 8 the "satisfactory" broadcast. (This is perhaps attributable to memories of school days.) Since the Appreciation Index numbers are employed only for purposes of comparison, this tendency does not vitiate their value, but it renders the 0/10 scale somewhat inelastic for the expression of exceptional pleasure, for while it leaves six possible marks for denoting degrees of dislike, it leaves only two for expressing pleasure greater than somewhat tepid approval.

At the time of writing a number of experiments are being made in the use of an alphabetical, instead of a numerical, system of marking. In all these experiments Panel members are requested to use the scale A, B+, B, B-, C. Different definitions for these five classes are being tested, but the intention throughout is to ensure, if possible, that "A" shall only be employed when the panel member feels the broadcast to have been a really outstanding success and "C" when he feels the broadcast to have been a failure.

The experiments have not yet gone far enough to permit of final conclusions, but the following example serves to illustrate the different results obtained by the two methods.

Two plays were both numerically and alphabetically marked by the Plays Panel, with the following results:

Play	Appreciation Index (average mark $\times 10$)	Percentage of alphabetical ratings				
		A	B+	B	B-	C
I	85	39	36	18	4	3
II	85	28	47	20	4	1

It will be seen that although the Appreciation Indices are identical, Play I was classed as an outstanding success (A) by 1.4 panel members for every one who placed Play II in this class.

who choose to hear them, and of locating the causes of success or failure," but it still remains to show that the answers of Listening Panel members can, in fact, be taken as representative of the wider audience. Panel members who report on a programme are not a random sample of those who have listened to it. Even though the panel may have been built up so as to correspond exactly, in terms of sex, age, social class and location, to the public for the type of programme with which it deals, those who complete questionnaires on any given programme, having been drawn from the ranks of those who volunteered to help in this work, are, in the final analysis, self-selected.

The crucial problem may be stated thus: other things being equal, do the reactions of people who volunteer to answer questions about broadcasts they hear differ from the reactions to the same programme of listeners who have not offered to co-operate? And if they do differ, what are the nature and significance of these differences?

A final solution of this problem could only be provided by carrying out parallel enquiries among panel members and among random samples of listeners. The scale of such enquiries would have to be considerable. The random samples of listeners would have to be interviewed. Even if the enquiries were to be confined to six programmes, and if 200 sample interviews about each one were considered adequate, it is probable that something of the order of 20,000 calls would have to be made before the necessary listeners to those programmes were located. To embark on such an enquiry in war-time is out of the question.

In the absence of definitive evidence, however, an hypothesis can be arrived at inductively. It will be obvious that a characteristic of a listener who gives voluntary service to listener research will be a more than normal interest in broadcasting. A listener who offered his services out of mere curiosity but without any deeper interest in broadcasting, and who happened to be selected for service, would very soon become bored and drop out. Panel members can, therefore, certainly be described as keen listeners.

Any supposition that their keenness will take the form of uncritical enthusiasm for all they hear can be dismissed, for as individuals, their ratings of broadcasts differ widely, even of broadcasts which fall within a category they may like as a type. One effect of panel members' abnormal interest in broadcasting is that, on the average, they listen much more than the general public. Evidence of this has emerged on several occasions when panel members have been asked to "log" their listening for a full week, and the resulting records have been compared with the findings of the Survey. This is in itself of no practical significance, for panels are not employed in the estimation of audience sizes. But the material which provides this evidence does throw light on the problem under discussion, for it shows that the choice which panel members exercise in selecting programmes to listen to corresponds very closely to that of the general public.

For example, in one enquiry of this kind (June 1942) a Listening Panel which consisted entirely of housewives, recruited as such and not on the basis of any particular programme preference, completed Listening Diaries for a week. The Diary covered nearly 180 heterogeneous programmes. When the results were compared with the findings of the Survey in respect of housewives, the coefficient of correlation was found to be 0.74. There was no reason to suppose that the opportunities for listening differed materially between the

two groups, and the high degree of correlation could, therefore, only mean that, in selecting programmes to be listened to, housewife panel members were exercising a taste which was substantially similar to that of the generality of housewives.

If, in the selection of programmes, the taste of panel members does not differ materially from that of the general public, even though their appetite for broadcast programmes may be greater, there is no reason to suppose that in their assessment of individual broadcasts the same does not apply.

To sum up: it is argued that, in default of more exhaustive evidence, a report upon a broadcast which is based upon answers given by an adequate number of listening panel members presents a picture of the way in which that broadcast has been received by the keener and more attentive of its listeners, and that the differences between such a report and one based on a random sample of the listeners to the broadcast, are differences not of kind, but of degree, because the tastes of panel members are merely those of average listeners writ large.

A Report on an Individual Broadcast

The normal working of the Listening Panel method can best be illustrated by giving in full the results of an enquiry on one particular broadcast. The example chosen is one entitled "Cutting Skipper," which was broadcast in September 1943. The programme was built around recordings made by B.B.C. staff in a bomber on an operation over Berlin. The recordings, as "hot news," had previously been included in a News Bulletin, but in this programme, which was produced at greater leisure, they were linked by the voice of a narrator and supplemented by additional material calculated to assist the listener in visualizing the action in perspective. This method of treating "actuality recordings" was experimental, and therefore particular importance was attached to gauging its reception by the public.

The following questionnaire was accordingly sent to the Feature Programmes Panel:

(1) Did you hear these recordings, made from a bomber over Berlin, when they were broadcast in the News? YES/DON'T REMEMBER/NO.

(2) For obvious reasons the recordings were not as good as they would have been if made under "ideal conditions"; do you think they were, nevertheless, worth broadcasting? DEFINITELY/RATHER DOUBTFUL/NO.

(3) Do you think the Narrator and the various voices, other than those recorded inside the bomber, made this programme more interesting? MUCH MORE/NOT PARTICULARLY/NO.

If not, would you have preferred the recordings to have been broadcast without any other matter? YES/NO.

(4) Would you please try to describe in a few words your feelings after having heard this broadcast?

(5) How far was this programme successful in giving a vivid picture of what it feels like to take part in a bombing raid? FULLY SUCCESSFUL/PARTIALLY SUCCESSFUL/QUITE UNSUCCESSFUL.

If it was not wholly successful, why was this?

(6) Please write any *other* comments here:

(7) In the light of your answers, how many marks do you give this broadcast? (Maximum 10). . . .

And on the basis of their replies, together with the estimated audience as derived from the Survey, the following report was written:

“CUTTING SKIPPER”

Tuesday, 28th September, 1943, 9.45–10.35 p.m., Home Service
(287 questionnaires were returned by the Feature Programme Panel.)

Extent of Listening. The audience for this programme was 15.8 per cent. This is exceptionally large for an isolated feature programme, being close to the average for the regular series “Marching On.”

Degree of Appreciation. The Appreciation Index was 92. This has only once been equalled before by a feature programme, “The Battle of Britain” six days earlier having also been awarded this Appreciation Index. Nine out of ten of the listeners reporting had heard the recordings upon which this programme was built when they were broadcast in the News. These listeners gave this programme even higher marks than did those who had not heard the recordings before.

General Reactions

(1) It was pointed out to listeners that for obvious reasons the recordings were not as good as they would have been if made under ideal conditions, and they were asked to say whether the recordings were, nevertheless, in their view worth broadcasting. 95 per cent. gave an emphatic affirmative.

(2) Listeners were asked whether the Narrator and the various voices, other than those actually recorded inside the bomber, made this programme more interesting. The great majority, nearly 80 per cent., considered that the additional material made the programme much more interesting, a minority (some 17 per cent.) thought their addition was of doubtful value, but only a few (4 per cent.) were quite positive that the interest-value of the recordings was not enhanced by feature treatment. About half of the minority who were not certain that the feature treatment was worthwhile, made it clear that they would definitely have preferred the actuality recordings to have been broadcast alone, but the necessity of the Narrator was appreciated by some of these. The particular fragment of the broadcast which seems to have caused some irritation was the dramatization of the German ack-ack crew.

(3) Listeners were asked to try to describe their own feelings after having heard this broadcast. The most commonly expressed feeling was one of admiration for the bomber crew and, not far short of it, admiration for the B.B.C. men who took part. A great many described the thrill which the broadcast gave them, and indicated that its realism enabled them to identify themselves with those who had been over Berlin that night. The matter-of-factness of the bomber crew also seems to have made a deep impression. Smaller numbers remarked upon the impression that the danger to the bomber crew made upon them, and expressed relief at its safe return. There were a few who took the occasion to deplore the necessity of bombing, while others expressed great satisfaction to have participated in the sensation of dropping a bomb on Berlin. A very small number said they were nauseated that B.B.C. staff should take part in making a “Roman holiday.” A very small number said that the broadcast evoked a feeling of sympathy with the bombed.

(4) When asked how far the programme was successful in giving a vivid picture of what it feels like to take part in a bombing raid, 80 per cent. replied

that it was fully successful, and the rest that it was only partially so. This minority, however, took the view that no broadcast could adequately convey such feelings, and not that this broadcast was a failure as such. There were, however, a small number who thought Vaughan Thomas's voice was too melodramatic in contrast to that of the crew, but others felt that this contrast, though it existed, heightened the effect of the programme. There were expressions of congratulation to Vaughan Thomas and Reg. Pidsley on their personal courage, and tributes to the B.B.C. for a notable achievement. Some listeners emphasized particularly the value and interest that lay in the authenticity of this broadcast. The only serious criticism of it was of the music, which a considerable number declared was unnecessary and irritating. The title also seems to have puzzled some listeners.

(5) The following are some typical comments of the majority of listeners :

"A magnificent programme, intensely realistic and brilliantly carried out. Production excellent. The connecting comments were apt and helpful. Congratulations to all concerned." (Retired.)

"I consider this the finest feature broadcast to date; authenticity and real atmosphere prevailed throughout. The feelings of air crews were vividly portrayed, and I am confident that an ordinary presentation by actors and sound effects, however good, could not have got over as this broadcast did. The linking sequences were extremely well done and expressed the thoughts I have had at many times. I fully visualized the whole trip that was presented, and this broadcast once again proved the B.B.C. to the forefront in presenting the news to the people at first hand. An emotional experience, difficult to describe in words." (Secretary.)

"A most exciting broadcast, and one that would stand repeating. Wynford Vaughan Thomas conveyed by his voice the tension and thrill of the trip, which would have been impossible to reproduce other than by direct recording. The recording was brilliant, having regard to the difficulties. Could we have recorded programmes from other arms—say a night action by M.T.B.s?" (Civil Servant.)

Summary. Despite a not very compelling title, this broadcast drew a large audience. It made a deep impression upon listeners who heard it, for no other feature programme on which a report has been written has been rated more highly. Listeners had no doubt that, despite the inevitable defects in the recordings, they were worth broadcasting, and the great majority thought that the feature treatment made them much more interesting. The broadcast evoked great admiration for the bomber crew and for the B.B.C. staff who took part. The matter-of-factness of the crew also made a deep impression. In general, it was felt that the programme, in so far as any broadcast programme could be, was fully successful in giving a vivid picture of what it feels like to take part in a bombing raid—a subject of profound and widespread interest.

LOCAL (CIVILIAN) AND FORCES CORRESPONDENTS

It has been shown that the Survey of Listening and the Listening Panels are designed for specific purposes, the former to provide estimates of the quantity of listening, and the latter estimates of the way in which individual programmes are received by the audiences which hear them. Although both systems have some elasticity, and can be employed for purposes other than their primary

objects, the degree of that elasticity is limited. On many, if not most, occasions when it is necessary that the B.B.C. should know the views of the public on broad questions of policy, the issues cannot be handled either by the Survey or by the Listening Panels. The types of question which fall outside the scope of these systems are of two broad kinds.

First, there are those which can only be satisfactorily answered by indirect means—*i.e.*, by an observer noting, unknown to those observed, their behaviour or comment. There are several different types of question which fall into this group. The most obvious case is where it is desirable to find out whether the public has, or has not, spontaneously commented upon some broadcast or broadcast policy decision. The indirect method must also be used if the question, because of its emotional overtone, is one to which it would be difficult to get reliable answers by the direct method. In the winter of 1939/40, the habit of listening to "Lord Haw-Haw" was very common. His broadcasts were at that time listened to nightly in one home in every three. Not to listen to Haw-Haw was to be behind the times, and no stigma of disloyalty attached to those who repeated his statements. At that time it was perfectly possible for interviewers to supplement their enquiries about B.B.C. programmes with a question asking whether Lord Haw-Haw had been switched on. But when the war in Western Europe opened up, and even more after Dunkirk, the whole situation changed. Listening to enemy broadcasts quickly came to be viewed with suspicion. Those who continued to do so—and there is reason to believe that they were very few in number—were reluctant to admit it. This meant that B.B.C. interviewers could no longer ask, with any hope of getting reliable replies, whether Lord Haw-Haw had been heard or not. Indeed, had they tried to do so, they would themselves have been suspected of being Fifth Columnists!

The second kind of question which falls outside the scope of the Survey and the panels includes those which either cannot be satisfactorily framed in a single short statement, or cannot be answered in black-and-white terms. Such questions cannot be put as supplementaries by Survey interviewers because the interview is a short one and the interviewer is normally a stranger to the informant. Questions which have to be preceded by a long explanation, or which call for a considered reply, are wholly out of place here. Such questions as these are not put to the Listening Panels, mainly because the panels are fully occupied with other tasks, but also because the panels are recruited as specialist groups and not as representatives of the listening public considered as a single whole.

Organization

In short, an adequate listener research service clearly calls for some special machinery for gauging public opinion on broad questions affecting broadcasting. Two types of organization were examined. One involved the employment of a small number of highly trained professional observers; the other the enlistment of a large corps of unpaid, though less skilled, observers. Attractive though the prospect of employing a small staff of professional social students might be, the project proved to have serious disadvantages. Recruitment in war-time would not be easy, and the cost would be considerable. Extensive geographical and social coverage would be impossible with a small staff, and the organization would be slow-moving where a large volume of

data was required. But there is a still bigger disadvantage in an organization based on a strictly limited personnel. The besetting danger in all observations of human behaviour is personal bias, particularly unconscious bias, on the part of the observer. The danger is magnified if the behaviour under observation relates to a social situation which affects the observer as much as the observed. Observers for broadcasting would not live in a vacuum, they would inevitably have their own feelings about the problems that were the subject of study. Evidence from a small group of observers would lack the only ultimate protection against the effect of personal bias: the law of averages.

It was, therefore, decided to recruit a large body of unpaid and amateur observers. Volunteers would not be expected to give more than a limited amount of time to the work, they could not be presumed to possess any extensive knowledge of broadcasting techniques, nor indeed expert knowledge of either human behaviour or of the nature and assembly of evidence. They would be ordinary men and women, probably of not much more than average intelligence, though with definitely more than average interest in broadcasting and goodwill to the B.B.C., who would be willing to engage in a certain amount, but not an unlimited amount, of altruistic activity.

It was not difficult to recruit observers. A broadcast talk on listener research, or an article in the *Radio Times*, would explain that the B.B.C. wanted to enlist as "Honorary Local Correspondents" listeners who, in the ordinary course of their daily activities, came into natural and easy contact with other listeners, and who would be willing periodically to answer questions about the views of their own circle on matters affecting broadcasting. The importance of securing Local Correspondents in all walks of life and from all parts of Great Britain would be stressed.

These appeals always create considerable interest, and offers come in numbers which make it possible to maintain the number of Local Correspondents at about 2,000. Naturally enough, the work makes particular appeal to people such as welfare workers, village shopkeepers, gas-meter readers, publicans, parsons, women's institute secretaries, trade union officials, youth organizers, insurance collectors, W.E.A. tutors, and the like. But the list of the occupations of Local Correspondents is much wider than this; indeed, it is safe to say that none of the major occupations in Great Britain go unrepresented. It is noticeable, however, that the occupational distribution of the volunteers is markedly skewed towards lower-middle-class occupations. This can to some extent, though not wholly, be corrected in the process of selecting volunteers for service. (It does not, however, seriously affect results, for middle-class and working-class results are separately analysed and, where they differ, are given appropriate weight in any tabulation of national findings.)

The questionnaire system is employed for Local Correspondents. Since the completion of a questionnaire involves him in "fieldwork," either in observations or in discussion of topics with his contacts, no Correspondent is required to complete more than one per month. He receives it on a Saturday, and is asked to post it back eight days later. Local Correspondents are divided into four equal sections, A, B, C and D, assignment to a particular section being made at random. Sections receive their questionnaires in successive weeks, so that, although receipt of a questionnaire is a monthly event for the individual Correspondent, batches are, in fact, returning to Broadcasting House weekly. This gives the system great flexibility, for different questions

may, if necessary, be sent to the separate sections, or, if an enquiry is a less urgent one, it may be put to all Local Correspondents. The following examples of answers given by different sections to identical questions illustrate the close comparability of the results obtained from the four sections of Local Correspondents. The first three come from an enquiry, undertaken for the Talks Department when they were planning a series of discussions on the British Colonial Empire.

Questions.		Section A, %	Section B, %	Section C, %
Do you think that <i>most</i> of your contacts realize that the term the " <i>Colonies</i> " does <i>not</i> include the Dominions?	Yes	28	27	31
	No	72	73	69
		100	100	100
In ordinary conversation do you usually find people using these two terms (Colonies and Dominions) accurately or not?	Yes	18	17	21
	No	82	83	79
		100	100	100
Among those of your contacts who have given any thought to the subject, which of the following four statements represents the view most commonly held?:				
"We have every right to be proud, and no need to feel at all ashamed, of our Colonial record" ...		10	19	15
"Our Colonial record is mixed, but the good exceeds the bad" ...		74	67	74
"Our Colonial record is mixed, and the bad exceeds the good" ...		11	10	9
"We ought to be ashamed of our Colonial record and have no right at all to be proud of it" ...		5	4	2
		100	100	100

Other examples may be taken from a questionnaire on early morning programmes:

Questions.		Section A, %	Section B, %	Section C, %	Section D, %
Is there any demand for programmes to start <i>earlier</i> than 6.30 a.m.?	Yes	10	13	12	11
	No	90	87	88	89
		100	100	100	100
Do those of your contacts who listen to the Forces Programme between 7.30 and 8.00 a.m. generally like the gramophone programmes which alternate at this time?					
(a) Morning Review?	Yes	87	91	87	83
	No	13	9	13	17
		100	100	100	100
(b) Rhythm on Records?	Yes	55	57	58	57
	No	45	43	42	43
		100	100	100	100

Another example may be taken from an enquiry on the relationship between Church attendance and listening to broadcast religious services:

Questions.		Section A, %	Section B, %	Section C, %	Section D, %
What proportion of those of your contacts who are <i>regular</i> churchgoers are also regular listeners to broadcast religious services?	All	6	8	6	5
	Great many	38	38	39	42
	A few	48	43	49	44
	None	8	11	6	9
		100	100	100	100

		Section A, %	Section B, %	Section C, %	Section D, %
What proportion of those of your contacts who <i>never</i> go to church are regular listeners to broadcast religious services?	All	0	1	2	1
	Great many	20	15	17	11
	A few	49	58	64	59
	None	31	26	17	29
		100	100	100	100

Correspondents, like panel members, and for the same reasons, are not appointed for any fixed term of office. There can be no insistence that they should return every questionnaire sent to them. But if a succession of questionnaires are missed, the Correspondent is asked if he still wishes to remain "active." The normal rate of return is between 60 per cent. and 70 per cent. of the questionnaires sent out.

Local Correspondents are not normally restricted in their reports to selecting one out of a number of predetermined alternative answers. They are encouraged to add supplementary comment. While it is, of course, necessary to tabulate the answers where tabulation is possible, it is not the usual practice to include statistical tabulations in the final reports derived from Correspondents' evidence. Neat statistical tables are all too apt to give the lay reader an impression of a degree of exactness in the results which is, in fact, unwarranted.

Reliability

What reliance is to be placed upon the collective evidence of Local Correspondents? No claim that it revealed the distribution of public opinion to within a small definable margin of accuracy could possibly be sustained. The nature of the method is such, for example, that though the number of Correspondents supplying the evidence is known, the number of persons questioned by Correspondents is not. This may, indeed, vary from question to question, and will certainly vary between one Correspondent and another. Yet though Correspondents' evidence does not make possible the measurement of public opinion in any but the broadest quantitative terms, it does at least represent a considerable advance upon the "intuitive" method of assessing public opinion, or that only too familiar "quantitative" method which relies upon a sample of five—my wife, the maid, and three men in the train. Until time and resources are available for methodological study and experiment, the precise degree of reliability to be attached to Local Correspondents' evidence must remain unknown. In the meantime the sheer size of the corps, its very wide geographical and social coverage, the way in which it is recruited, the honorary nature of membership, and the regularity with which the method produces results which are confirmed from other sources when confirmation is possible, are all factors which encourage confidence in the Local Correspondent method.

FORCES CORRESPONDENTS

Contact with listeners in H.M. Forces in Great Britain presents special, and to some extent insoluble, problems. Anything in the nature of sample survey by means of interviews is, of course, impracticable. From time to time special arrangements have been made with Service Ministries for posting a questionnaire to every *n*th member of a Service. Despite the fact that this method has the limitations that attach to any enquiry the replies to which come only from those who are sufficiently interested to take part, it is extremely

useful as a means of assessing basic tastes. But its cumbersomeness rules it out as a method of continuous contact. A body of Forces Correspondents, analogous in function to Local (Civilian) Correspondents, has, therefore, been enrolled. Members are recruited from all three Services, and the strength is some 600. Monthly questionnaires are sent to each Forces Correspondent, but the fluidity of the Forces and their inevitably difficult listening conditions are reflected in a low rate of return which averages 40 per cent.

OTHER METHODS

The methods described above constitute the standing machinery of listener research today. From time to time, however, problems are posed which fall outside their scope. Special machinery has then to be created. Two examples will illustrate such cases. A study of children's reactions to Children's Hour was recently called for. Questionnaires were therefore sent to the children of voluntary listener research workers. Their parents were requested to allow the children complete freedom of expression, but a separate form was provided for the parents' use. A study of the impact of a series of Sunday religious addresses in the spring of 1944, under the title "Man's Dilemma and God's Answer," necessitated the enlistment of a special Religious Addresses Panel. This panel differed in one fundamental respect from the Listening Panels described above, for membership was open to all who were prepared to co-operate, regardless of whether they were normally listeners to religious broadcasts or not. Naturally, the results were not put forward as representing those of the normal audience to religious broadcasts. They were classified in terms of the previous religious views of the listeners taking part in the enquiry.

CONCLUSION

The business of listener research is to interpret the listener to the broadcaster. To do this successfully calls for much more than the invention of appropriate forms of organization and the application of relevant statistical techniques. Whoever is responsible for carrying out listener research must begin by understanding the broadcaster and his problems. Unless he does this, much of his effort will be wasted. He must first be prepared to enter into the minds of his "clients" and see their problems through their eyes. These problems, incidentally, will be very varied. Within the same day he may be concerned with a series of religious addresses, Tommy Handley in Itma, a dramatic documentary on paratroops, a concert of contemporary music, and a talk on cookery. Though his identification with his "client" must be complete, he must at the same time preserve his objectivity. He must gather his material quickly without sacrificing thoroughness. He must strain every effort to provide the information which is needed, but when necessary he must be prepared to admit that his tools are inadequate for some job he is asked to do. Finally, in presenting his results he must maintain, and be known to maintain, strict standards of impartiality, for only so will he retain the confidence of those who use his findings.

This paper might perhaps have been more aptly titled "Listener Research in War-time," for the exigencies of war-time broadcasting have had a profound effect upon its development. The necessity for the strictest economy, both in the costs of operation and in the staffing of broadcasting, has increased the

need for listener research, and has resulted in a war-time expansion of its activities. At the same time, listener research has by no means been free from the restricting effects of the need for economy, and its war-time development has consequently been somewhat one-sided, for purely methodological studies, so necessary as fertilizing agents, have had to be greatly restricted. Post-war plans must provide for their resumption if listener research is to develop healthily in future.

Yet one war-time measure—the restriction of the number of alternative programmes for home consumption to two—has simplified the problem of providing an adequate listener research service. When, after the war, the B.B.C. is able to provide a fuller and more comprehensive broadcasting service, certainly offering more than two alternative programmes, the experience which war-time conditions have made possible will undoubtedly prove to have been of very real value.

Finally, nothing has so far been said about the use to which the B.B.C. puts listener research. This is, strictly speaking, outside the scope of this paper, yet it should be mentioned as it is not infrequently misunderstood. From the first the clearest distinction has rightly been maintained between listener research as a fact-finding activity, and the function of policy-making. It is for listener research to find the facts and to ensure that their significance is understood by those concerned. It is for those responsible for policy-making to take those facts into account, together with all other considerations which are relevant to the problem at issue. The B.B.C. is highly sensitive to the needs and wishes of its public, and regards its Listener Research Department as performing an indispensable function in the business of broadcasting, at the same time it is equally sensitive of its obligation to lead, rather than to follow public taste.

TABLE I

Normal Limits within which Audiences Varied

News Bulletins during period March 1st–September 30th, 1943. Other series or types of programme January 1st–September 30th, 1943. Material derived from the Survey of Listening.

Title or Type, with day, starting time, and service (H. = Home Service, F. = Forces Programme)	No. of cases	Limits embracing					
		50% of instances		80% of instances		100% of instances	
		Lower	Upper	Lower	Upper	Lower	Upper
<i>News Bulletins, Monday–Friday</i> (excluding Bank Holidays)		%	%	%	%	%	%
7.00 a.m. (H. & F.) ...	152	21.4	23.9	20.3	26.2	17.2	28.7
8.00 a.m. (H. & F.) ...	152	33.0	36.9	31.0	37.7	28.3	44.6
1.00 p.m. (H. & F.) ...	152	38.0	41.9	37.1	43.0	34.6	46.9
6.00 p.m. (H. & F.) ...	152	40.0	45.1	39.0	47.2	35.2	49.3
9.00 p.m. (H. & F.) ...	152	48.3	54.0	46.0	57.0	42.9	64.9*
Midnight (H.) ...	152	5.0	6.6	4.1	7.2	2.8	8.8
<i>Saturdays</i>							
7.00 a.m. (H. & F.) ...	31	21.0	24.8	19.7	24.9	17.9	26.9
8.00 a.m. (H. & F.) ...	31	31.0	34.9	30.3	36.4	28.4	41.1
1.00 p.m. (H. & F.) ...	31	40.5	43.7	38.0	44.9	35.2	48.6
6.00 p.m. (H. & F.) ...	31	42.0	47.0	38.8	48.6	36.5	51.4
9.00 p.m. (H. & F.) ...	31	42.2	48.6	40.8	49.9	38.1	52.6
Midnight (H.) ...	31	8.1	11.0	6.9	11.4	5.6	14.3
<i>Sundays</i>							
7.00 a.m. (H. & F.) ...	31	6.6	8.7	6.2	9.3	5.5	10.2
9.00 a.m. (H. & F.) ...	31	35.4	39.7	33.2	40.7	31.4	42.8
1.00 p.m. (H. & F.) ...	31	49.2	52.6	47.8	54.8	45.3	57.7
6.00 p.m. (H. & F.) ...	31	40.2	45.9	39.6	47.5	38.8	52.0
9.00 p.m. (H. & F.) ...	31	46.7	52.7	45.5	56.1	44.4	67.6†
Midnight (H.) ...	31	3.4	5.5	2.8	5.7	2.1	7.7
<i>Spoken Word</i>							
Sunday Night Postscript, 9.15 p.m. (H. & F.) ...	34	29.1	32.4	26.8	35.5	24.1	39.8
Brains Trust (Original B'cast), Tues., 8.15 p.m. (H.) ...	24	18.7	22.3	17.9	25.0	17.7	25.8
(Repeat), Sun., 4.15 p.m. (F.) ...	24	14.0	17.1	13.4	18.0	10.4	18.4
War Commentary, Thurs., 9.20 p.m. (H.) ...	36	18.2	21.7	16.9	24.1	14.7	26.4
Kitchen Front, Daily, 8.15 a.m. (H. & F.) ...	220	14.0	17.4	13.1	18.9	9.6	21.3
John Hilton Talking, Tues., 5.45 p.m. (F.) ...	24	13.8	16.6	13.4	17.2	12.0	18.5
World Goes By, Wed., 7.00 p.m. (F.) ...	37	12.1	15.7	11.5	17.9	8.6	19.4
Tonight's Talk, Tues. & Fri., 9.20 p.m. (H.) ...	71	10.0	13.7	8.3	16.0	5.1	19.2
Radio Reconnaissance, Mon., 9.20 p.m. (F.) ...	32	10.5	13.1	8.0	15.6	6.6	18.7

* Highest figure recorded, 64.9 per cent., was for a bulletin preceded by speech by the Prime Minister. Second highest, 64.0 per cent., for night when news of Italian surrender announced. Excluding these, maximum figures would be 60.5 per cent.

† Highest figure recorded, 67.6 per cent., was for a bulletin preceded by speech by the Prime Minister. Second highest, 62.6 per cent., for bulletin preceded by speech by H.M. the Queen. Excluding these, maximum figure would be 57.4 per cent.

TABLE I—continued

Title or Type, with day, starting time, and service (H. = Home Service, F. = Forces Programme)	No. of cases	Limits embracing					
		50% of instances		80% of instances		100% of instances.	
		Lower	Upper	Lower	Upper	Lower	Upper
		%	%	%	%	%	%
<i>Spoken Word</i> —continued							
American Commentary, Sat., 9.20 p.m. (H.) ...	31	10.2	12.8	9.5	13.1	8.6	14.9
Week's Films, Sun., 5.50 p.m. (F.) ...	18	8.7	10.6	6.4	11.7	5.9	12.4
In Your Garden, Sun., 2.15 p.m. (H.) ...	39	7.6	9.8	5.9	10.5	4.0	12.5
Short Story Readings, Wed., 10.15 p.m. (F.) ...	34	7.6	9.1	7.0	11.1	4.9	12.0
Week in Westminster, Sat., 7.45 p.m. (H.) ...	33	4.5	6.9	4.1	7.5	3.2	8.2
Mostly for Women, Sun., 12.50 p.m. (H.) ...	30	5.2	6.8	4.3	7.9	3.6	8.7
Adult education talks series, Mon. & Fri., abt. 7.30 p.m. (H.) ...	34	4.0	6.4	3.0	7.1	2.0	9.3
What I'm Reading Now, Sat., 10.15 p.m. (F.) ...	18	4.0	5.6	3.7	5.9	3.4	8.0
<i>Radio Drama</i>							
Plays, Miscellaneous							
Sun., abt. 3.30 p.m. (H.) ...	27	6.1	9.9	4.6	11.3	3.0	14.3
Sun., abt. 9.30 p.m. (H.) ...	22	9.9	13.4	6.8	15.2	5.5	16.2
Mon. & Wed., abt. 9.30 p.m. (H.) ...	20	11.0	13.3	10.4	14.0	4.6	20.0
Fri., abt. 6.40 p.m. (F.) ...	33	9.6	13.4	8.7	14.2	7.1	17.5
Saturday Night Theatre, 9.35 p.m. (H.) ...	19	15.3	17.3	11.1	17.3	8.6	17.3
Serial Plays, Miscellaneous							
Mon., abt. 7.00 p.m. (H.) ...	20	7.5	9.3	7.1	11.3	6.0	13.0
Feature (documentary) Programmes							
Miscellaneous, Mon.—Fri., bet. 8.00 & 9.00 p.m. (H.) ...	20	6.3	8.9	5.0	10.4	4.0	16.2
abt. 9.25 p.m. (H.) ...	24	7.0	11.1	4.8	15.9	2.8	23.9
abt. 10.15 p.m. (H.) ...	19	3.7	5.9	2.2	6.7	1.5	7.5
Country Magazine, Sun., 1.15 p.m. (H.) ...	19	5.9	8.0	4.8	9.7	4.6	10.4
Salutes & Battle Honour, Sun., 8.45 p.m. (H.) ...	19	8.7	12.1	7.5	13.7	6.2	17.7
What the Poet Sees, Sun., 10.15 p.m. (H.) ...	18	1.6	2.2	1.1	2.7	0.7	2.9
Into Battle, Tues. & Sat., 9.20 p.m. (F.) ...	71	13.0	16.7	12.3	19.0	9.8	20.7
Marching On, Thur., 9.40 p.m. (H.) ...	33	15.1	17.8	14.1	19.4	13.1	21.2
<i>Music</i>							
Serious							
Concerts, Miscellaneous, Sun., 2.30 p.m. (H.) ...	39	3.4	4.9	3.0	6.5	2.1	8.8
Symphony, Wed., bet. 7.00 & 8.00 p.m. (H.) ...	30	5.6	6.9	4.6	7.6	1.9	9.4
Miscellaneous, Fri., 1.15 p.m. (H.) ...	37	4.2	5.8	4.0	8.1	2.7	9.5
Sat., 2.30 p.m. (H.) ...	31	2.4	3.9	2.0	4.9	0.6	6.4

TABLE I—continued

Title or Type, with day, starting time, and service (H. = Home Service, F. = Forces Programme)	No. of cases	Limits embracing					
		50% of instances		80% of instances		100% of instances	
		Lower	Upper	Lower	Upper	Lower	Upper
		%	%	%	%	%	%
Music—continued							
Serious							
Promenade, Weekdays, 7.00 p.m. (H.) ...	34	7.2	9.5	6.4	10.3	5.5	12.9
Opera, Wed., bet. 6.45 & 7.45 p.m. (H.) ...	11	7.0	10.2	6.7	11.0	6.3	11.1
Music Lovers' Calendar (Talk) Sun., 11.00 a.m. (H.) ...	39	3.0	4.2	2.6	4.9	1.6	6.0
Light							
Grand Hotel, Sun., 8.20 p.m. (F.)	23	20.4	25.5	19.1	26.7	18.3	27.9
Music While You Work, played by dance bands, military bands and brass bands Sun., 10.30 a.m. (H.) ...	39	16.0	18.9	15.9	20.6	12.8	21.1
Weekdays, 10.30 a.m. (H. & F.) ...	158	11.0	13.6	10.1	15.7	6.2	20.1
Weekdays, 10.30 a.m. (F.) ...	67	10.2	12.7	8.7	13.6	5.5	16.9
Sat. & Sun., 3.00 p.m. (F.) ...	77	10.1	12.5	9.2	14.9	7.6	16.2
Weekdays, 3.00 p.m. (H. & F.) ...	183	9.0	11.2	7.6	12.1	5.3	14.3
Daily, 10.30 p.m. (F.) ...	273	11.0	14.2	10.0	16.9	6.5	22.7
Forces Choice (gram. records), Sun., abt. 5.20 p.m. (F.) ...	20	9.8	12.8	9.1	13.9	7.8	14.8
These You Have Loved (gram. records), Tues., early evening (F.) ...	18	17.2	22.4	16.3	23.8	13.2	27.0
Tuesday Radiogram (gram. records), Tues., 10.00 p.m. (F.) ...	34	10.1	11.9	8.3	13.5	5.5	16.0
Radio Rhythm Club (swing), Thurs., 6.30 p.m. (F.) ...	29	7.7	9.9	7.4	11.2	5.5	13.9
Theatre Organ, Weekdays, bet. 6.30 & 9.00 p.m. (F.) ...	21	12.7	14.6	10.8	18.5	10.2	23.8
B.B.C. Dancing Club, Wed., 7.30 or 8.00 p.m. (F.) ...	34	19.0	23.4	16.6	27.0	11.8	27.9
Dance Music, Mon.-Fri., bet. 11.00 p.m. & midnight (H.) ...	146	4.0	5.9	3.6	6.9	2.4	9.5
Sat., bet. 11.00 & midnight (H.) ...	38	7.8	10.2	6.4	11.5	5.5	12.4
Religious Broadcasts							
Services, Sun., 9.30 a.m. (H.) ...	39	12.1	14.8	11.2	16.4	10.0	18.8
Sun., 8.00 p.m. (H.) ...	39	7.3	9.6	6.9	11.5	5.9	14.0
Sun., 10.15 a.m. (F.) ...	37	5.2	6.8	4.9	7.7	3.6	9.0
Weekdays, 10.15 a.m. (H.) ...	234	5.6	6.9	5.0	7.9	3.5	9.9
Thurs., abt. 10.15 p.m. (H.) ...	15	5.8	6.4	5.0	7.3	4.1	8.0
Sat., abt. 10.15 p.m. (H.) ...	36	4.0	5.7	3.7	6.1	3.3	6.8
Epilogue, Sun., abt. 10.00 p.m. (F.) ...	37	5.0	6.7	4.0	7.8	3.3	8.4
Sun., abt. 10.30 p.m. (H.) ...	36	2.3	3.3	2.1	4.3	1.6	6.9
Lift Up Your Hearts, Weekdays, 7.55 a.m. (H.) ...	234	8.8	11.0	8.0	11.9	5.5	15.9
Talks, Sun., 2.50 p.m. (F.) ...	34	4.2	5.6	3.5	6.0	2.5	6.9
Sun., 4.45 p.m. (H.) ...	26	2.1	3.0	1.4	3.0	1.1	5.3
Anvil, Thurs., 8.00 p.m. (H.) ...	13	8.0	9.5	7.9	10.2	6.2	10.7

TABLE I—continued

Title or Type, with day, starting time, and service (H. = Home Service, F. = Forces Programme)	No. of cases	Limits embracing					
		50% of instances		80% of instances		100% of instances	
		Lower	Upper	Lower	Upper	Lower	Upper
<i>Religious Broadcasts—continued</i>		%	%	%	%	%	%
Anvil, Fri., 7.25 p.m. (H.) ...	17	3.8	5.5	3.2	6.4	2.0	8.4
Tues., 10.15 p.m. (H.) ...	10	4.2	4.6	3.6	4.7	3.3	5.1
Radio Padre, Wed., 9.25 p.m. (F.) ...	39	14.1	18.2	13.1	18.7	10.3	19.5
Week's Good Cause, Sun., 8.40 p.m. (H.) ...	39	5.0	8.0	4.3	8.5	3.9	10.9
<i>Light Entertainment</i>							
Workers' Playtime, Sun., 11.30 a.m. (F.) ...	39	15.0	18.8	14.0	19.8	12.3	20.8
Tues. & Thurs., 12.30 p.m. (H. & F.) ...	77	22.1	24.9	20.3	25.8	18.1	28.9
Bob Hope Programme, Sun., 12.35 p.m. (F.) ...	19	17.9	21.1	15.8	22.3	14.1	23.4
Fred Allen Programme, Sun., 12.35 p.m. (F.) ...	12	15.1	16.2	13.2	17.3	12.6	17.3
Happidrome, Sun., 7.10 p.m. (F.)	30	30.1	35.9	29.3	41.3	28.5	44.1
Stage Presents, Sun., 9.30 p.m. (F.) ...	22	20.0	23.2	19.8	24.8	18.9	25.9
Break for Music, Mon., 12.30 p.m. (F.) ...	29	20.1	22.3	19.3	23.2	16.5	24.7
Fri., 12.30 p.m. (H. & F.) ...	38	21.1	24.2	20.1	26.7	18.6	36.7†
Ack-Ack, Beer-Beer, Mon., 5.15 p.m. (F.) ...	39	12.0	14.7	11.6	15.9	10.7	17.9
Command Performance, Mon., abt. 7.00 p.m. (F.) ...	38	14.0	19.6	12.0	20.4	9.5	22.0
Monday Night at Eight, Mon., 8.00 p.m. (H.) ...	12	28.9	39.0	27.4	40.0	27.1	40.6
Old Town Hall, Tues., 7.45 p.m. (H.) ...	14	23.9	27.6	22.4	29.4	20.1	31.3
Works Wonders, Wed. & Sat., 12.30 p.m. (H.) ...	70	16.3	19.9	15.2	21.9	13.1	23.3
ENSA Half-Hour, Wed. or Thurs., abt. 7.30 p.m. (F.) ...	34	15.4	20.2	13.3	22.9	11.1	26.1
Northern Music Hall, Wed., 8.30 p.m. (F.) ...	28	23.7	27.8	20.3	31.6	17.3	35.0
Itma (1st perf.), Thurs., 8.30 p.m. (H.) ...	17	27.9	32.0	24.1	32.0	21.7	33.8
(Repeat) Sun., 1.15 p.m. (F.)	22	22.0	24.1	21.0	26.0	20.6	28.2
Mail Call, Thurs., abt. 9.25 p.m. (F.) ...	35	11.1	14.5	10.1	15.2	8.8	16.2
Tommy Get Your Gun, Fri., 8.30 p.m. (F.) ...	15	22.1	25.4	21.5	29.8	20.8	32.6
Jack Benny Programme, Fri., 9.30 p.m. (F.) ...	32	17.0	19.6	16.0	20.4	14.8	21.1
Shipmates Ashore, Sat., 5.30 p.m. (F.) ...	39	17.2	20.8	16.0	24.1	14.0	31.7§
Red Cross Radio Contest (1st perf.), Sat., 6.30 p.m. (F.) ...	11	16.0	21.8	13.7	22.6	13.8	23.7
(Repeat) Mon., 9.40 p.m. (F.)	11	15.4	17.9	14.1	18.6	13.8	18.8
Music Hall (1st perf.) Sat., 8.00 or 8.15 p.m. (F.) ...	20	31.3	35.1	26.4	38.6	25.5	41.3
(Repeat) Wed., 4.00 p.m. (F.)	11	7.5	8.9	6.5	9.3	6.0	10.0

† Highest figure recorded, 36.7 per cent., was for programme featuring Gracie Fields. Excluding this, maximum figure would be 27.4 per cent.

§ Highest figure recorded, 31.7 per cent., was for programme in which Gracie Fields figured as Guest Artist. Excluding this, maximum figure would be 25.3 per cent.

TABLE II
*The Attitude of the Listening Public * towards Sixteen Types of Programme Output*

Type of output, with date of enquiry and approximate size of sample	Distribution of attitudes †					
	A	B	C	D	E	Total
Variety (Oct. 1943, 5,300)	43	30	16	7	4	100
Plays (Aug. 1943, 5,200)	34	22	22	13	9	100
Musical Comedies (Nov. 1943, 5,400) ...	32	31	22	10	5	100
Military Bands (Oct. 1943, 5,300) ...	32	29	22	10	7	100
Cinema Organs (Aug. 1943, 5,100) ...	32	26	23	10	9	100
Feature (documentary) Programmes (Nov. 1943, 5,200)	29	31	27	9	4	100
Brass Bands (Aug. 1943, 5,200)	29	26	22	13	10	100
Discussions (Aug. 1943, 5,200)	23	18	22	18	19	100
Religious Services (Sept. 1943, 5,400) ...	22	30	23	16	9	100
Short Story Readings (April 1944, 5,400)	20	24	26	17	13	100
Dance Music (Oct. 1943, 5,200)	19	22	24	20	15	100
Talks (Sept. 1943, 10,600)	18	27	25	17	13	100
Symphony Concerts (July 1943, 5,200) ...	13	13	18	21	35	100
Grand Opera (May 1944, 5,200)	12	17	21	21	29	100
Poetry Readings (Sept. 1943, 5,100) ...	6	12	20	27	35	100
Chamber Music (July 1943, 5,100)	6	9	16	23	46	100

* All persons over the age of 16, other than those in the Armed Forces, with regular access to a wireless receiver.

† A = Enthusiastic, B = Moderately Favourable, C = Neutral, D = Moderately Unfavourable, E = Hostile.

TABLE III
*Changes in the Attitude of the Listening Public * over Three Years*

Type of output, with date of enquiry and approximate size of sample	Distribution of attitudes †					
	A	B	C	D	E	Total
Variety	%	%	%	%	%	%
Sept. 1941, 4,900	51	28	13	5	3	100
Sept. 1942, 4,900	35	33	20	9	3	100
Oct. 1943, 5,300	43	30	16	7	4	100
Plays						
July 1941, 4,700	20	27	25	19	9	100
Aug. 1942, 4,900	31	24	23	12	10	100
Aug. 1943, 5,200	34	22	22	13	9	100
Musical Comedies						
Oct. 1941, 4,800	30	24	23	14	9	100
Sept. 1942, 4,800	24	27	28	14	7	100
Nov. 1943, 5,400	32	31	22	10	5	100
Military Bands						
Oct. 1941, 4,900	25	25	24	15	11	100
Oct. 1943, 5,300	32	29	22	10	7	100
Cinema Organs						
Aug. 1941, 4,500	34	26	23	10	7	100
Aug. 1942, 5,000	27	23	27	13	10	100
Aug. 1943, 5,100	32	26	23	10	9	100

* All persons over the age of 16, other than those in the Armed Forces, with regular access to a wireless receiver.

† A = Enthusiastic, B = Moderately Favourable, C = Neutral, D = Moderately Unfavourable, E = Hostile.

TABLE III—continued

Type of output, with date of enquiry and approximate size of sample	Distribution of attitudes †					
	A	B	C	D	E	Total
Feature (documentary) Programmes	%	%	%	%	%	%
Nov. 1941, 14,200	16	25	32	19	8	100
Nov. 1942, 4,800	20	24	30	18	8	100
Nov. 1943, 5,200	29	31	27	9	4	100
Brass Bands						
Aug. 1941, 5,000	21	24	25	17	13	100
Aug. 1942, 5,000	21	23	27	17	12	100
Aug. 1943, 5,200	29	26	22	13	10	100
Discussions						
Aug. 1941, 4,800	20	19	24	21	16	100
Nov. 1942, 4,800	17	21	28	23	11	100
Aug. 1943, 5,200	23	18	22	18	19	100
Religious Services						
Sept. 1941, 4,900	17	24	30	18	11	100
Sept. 1942, 4,800	21	26	27	17	9	100
Sept. 1943, 5,400	22	30	23	16	9	100
Short Story Readings						
Jan. 1942, 9,600	17	23	30	19	11	100
April 1944, 5,400	20	24	26	17	13	100
Dance Music						
Oct. 1941, 4,900	28	25	22	14	11	100
Sept. 1942, 4,800	22	25	24	17	12	100
Oct. 1943, 5,200	19	22	24	20	15	100
Talks						
Oct. 1941, 4,800	26	21	24	16	13	100
Oct. 1942, 4,900	18	23	27	21	11	100
Sept. 1943, 10,600	18	27	25	17	13	100
Symphony Concerts						
Sept. 1941, 4,800	10	13	17	20	40	100
Aug. 1942, 4,700	11	14	24	23	28	100
July 1943, 5,200	13	13	18	21	35	100
Grand Opera						
Mar. 1942, 9,500	11	14	25	25	25	100
Feb. 1943, 5,000	11	15	26	27	21	100
May 1944, 5,200	12	17	21	21	29	100
Poetry Readings						
Sept. 1941, 4,800	6	13	23	24	34	100
Oct. 1942, 4,900	7	12	21	29	31	100
Sept. 1943, 5,100	6	12	20	27	35	100
Chamber Music						
Aug. 1941, 5,000	5	8	17	24	46	100
Aug. 1942, 4,900	7	11	21	23	38	100
July 1943, 5,100	6	9	16	23	46	100

TABLE IV
*Comparison of the Attitude of Listeners * of Different Kinds towards Sixteen
 Types of Programme Output*

Type of output, with date of enquiry and approximate size of sample	Percentage classified as "enthusiastic"								
	Upper- Middle Class	Lower- Middle Class	Work- ing Class	Men	Women	Age Groups			
						16-19	20-29	30-39	50+
Variety	%	%	%	%	%	%	%	%	%
Oct. 1943, 5,300 ...	30	36	46	43	44	60	49	44	37
Plays									
Aug. 1943, 5,200 ...	47	40	31	31	36	29	35	36	32
Musical Comedies									
Nov. 1943, 5,400 ...	30	32	33	26	37	31	35	33	31
Military Bands									
Oct. 1941, 4,900 ...	27	31	32	39	27	30	28	33	33
Cinema Organs									
Aug. 1943, 5,100 ...	24	29	34	28	35	35	35	32	30
Feature (documentary) Progs.									
Nov. 1943, 5,200 ...	38	34	27	32	27	28	27	30	28
Brass Bands									
Aug. 1943, 5,200 ...	28	31	28	37	23	20	20	30	32
Discussions									
Aug. 1943, 5,200 ...	43	34	19	28	20	16	18	24	26
Religious Services									
Sept. 1943, 5,400 ...	28	23	21	18	24	10	16	20	27
Short Story Readings									
April 1944, 5,400 ...	31	28	17	18	21	16	20	21	21
Dance Music									
Oct. 1943, 5,200 ...	9	13	22	15	22	54	34	17	9
Talks									
Sept. 1943, 10,600 ...	44	27	14	22	16	10	14	19	21
Symphony Concerts									
July 1943, 5,200 ...	29	23	9	14	13	9	13	14	14
Grand Opera									
May 1944, 5,200 ...	24	18	10	11	13	10	12	12	14
Poetry Readings									
Sept. 1943, 5,100 ...	11	10	4	5	6	4	6	6	6
Chamber Music									
July 1943, 5,100 ...	20	9	4	7	5	3	5	7	7

* All persons over the age of 16, other than those in the Armed Forces, with regular access to a wireless receiver.

DISCUSSION ON MR. SILVEY'S PAPER

MR. E. C. FIELLER, in proposing a vote of thanks, said:

The author is to be congratulated on presenting a paper that will be of interest to the public, as well as to statisticians. It is a good thing if from time to time we remember that the public constitute what Pearsall Smith called "the unpraised, unrewarded millions without whom statistics would be a bankrupt science." In return statisticians ought perhaps to tell the public what it looks like to them rather more frequently than they do. Listening to the wireless with anything from half an ear upwards must by now be almost a universal occupation. I was hoping that the author would give us a percentage that would

tell us how nearly universal it is. He does not tell us that, but what he does tell us—and I found it interesting that he took it almost for granted—is that within 24 hours or so we have forgotten what we have heard. The author's tables do not enable us to reconstruct the programme that the average listener would choose, but I think they do give us in a broad way a good picture of the sort of thing that the average listener is prepared to accept.

The technique by which the author gets his results is one that became familiar before the war under the name of consumer or market research. It is, I think, a difficult technique, but when it is well applied the results in their final presentation have a deceptive appearance of simplicity. Looking through the paper, I found that a correlation coefficient was mentioned twice, and that his main table at the end was given in the form of percentiles, but the basic weapon that he used in attacking his problems was the ordinary percentage. The student of mathematical statistics may at first sight think that that sort of job is easy; after experience of both sorts of work, I think that if anything the boot is on the other foot.

The design and analysis of controlled experiments is a procedure that can now, as far as the statistician is concerned, be followed almost mechanically. In the field of consumer research, however, there is as yet no such well-established technique. The investigator usually starts with a list of problems that are at best only vaguely formulated; as a first step he has to clarify them, and clarify them moreover into something that he can tackle within fairly rigid limitations of time and cost. The wider the field of investigation, the more difficult this is, and it is not surprising that it should have taken, as Mr. Silvey mentions, three years of experimenting to evolve the B.B.C.'s present routine. The services that it had to provide, as listed near the beginning of Mr. Silvey's paper, are all described subjectively; the first of them, for instance ("the quantity of listening to each broadcast"), is vague because "listening" means different things to different people. It is interesting to note that Mr. Silvey gets over this particular difficulty by utilizing it—he tells his interviewers to use their own judgment and common sense, and thus in effect adopts a statistical definition of "listening." This seems to me to be a more realistic solution than that adopted before the war, by an American market research agency, of automatically recording the times and wave-lengths at which a random selection of householders switched on their sets.

As already mentioned, speed and economy are usually essentials in the production of the results of any "consumer investigation," and it seems a real achievement, in this connection, that the Daily Barometer should appear within seven days of the actual broadcast. The employment of part-time interviewers, working near their homes, must reduce the cost per interview by at least half, and putting the onus on them of deciding how the listeners' answers should be classified, by eliminating any temptation that the sorters at headquarters might otherwise feel to think about the answers, also makes for speed and economy.

On the technique of the interview I have one or two questions to ask. Is the financial division into social grades, which was devised for investigations ultimately concerned with extracting money from people, necessarily appropriate here, where the matter is, as Mr. Silvey says, one of education and culture? A University lecturer, for instance, will on the financial basis take some years to climb out of the lower middle class. Are the people who habitually join food-queues, who are presumably easy to interview, typical of the listening public as a whole? And if the interviews are conducted away from the listeners' homes, may not the interviewer find it difficult to assess their social grade, and be tempted to guess it by reference to their listening habits? A final query—is it possible to obtain, by the technique described in the paper, sufficient opinions on Saturday programmes? I should expect the public to be much less accessible on Sundays than on week-days.

A point that I like, in the organization of the survey of listening, is the intermittent nature of the interviewer's employment—it should do much to eliminate the boredom and fatigue that continuous work of this kind usually

develops. Has Mr. Silvey considered doing the same with his listening panels? This might control a tendency that I would expect their members to exhibit, to become progressively more sensitive, once they form the habit of reporting on programmes, to the differences between the good and the bad. Just as interviewers must avoid suggesting answers, so must the author of the printed questionnaire. In this respect two of the questions asked about the bombing broadcast seem open to criticism—the fifth, which could be fairly put only to bomber crews, and the second, to which people who wanted to answer “yes” had to say “definitely.” The report on the enquiry says that in answer to this question 95 per cent. of listeners “gave an emphatic affirmative.” They had no chance to give any other sort of affirmative.

When one has enjoyed something, as I have enjoyed this paper, it is natural to ask for more. That must be my excuse for saying that I would like to have heard in greater detail the uses to which the B.B.C. puts Mr. Silvey's results. Are those mysterious policy-makers, who momentarily surface in the last paragraph of the paper, merely made happier at their work when they see the figures, or do they base their day-to-day decisions on them? And if so, how? I fear that I might be tempted, if I were responsible for policy-making, and if I myself liked a programme, to say, “Oh, well, 40 per cent. of the people like this, and only 4 per cent. object, so we will keep it on”; and, on the other hand, if I thought the programme bad for the public, I might say, “Only 40 per cent. like this, and 4 per cent. definitely object to it, so we will take it off.” I should like the author to tell us what is the policy-maker's view of his work. I am very glad to have the opportunity of proposing a vote of thanks to Mr. Silvey.

MR. TIPPETT, in seconding the vote of thanks, said: I have never worked in this field of consumer research, and so can properly express admiration for the results achieved in what appears to be a very difficult subject. The first comment that might be put forward is that these surveys ought never to be made; people who make this comment state that our governors should lead and not follow public opinion. It is an irrelevant comment; but the author has dealt adequately with it at the end of his paper. We, as scientists, must declare our faith in knowledge as a good thing, irrespective of the use made of it. The second kind of comment concerns the results themselves. They are undoubtedly interesting to the outside person, and I suppose they are valuable to the B.B.C. There is not much that I can say about these results except to ask the author if he could make Table I a little clearer. I had to examine it very closely before I could understand what the figures meant.

A third line of comment concerns the methods. I am reminded of the fictitious story of a leader-writer of a newspaper who had to write on the delicate subject of vivisection at a time when a Vivisection Bill was before Parliament. Probably half his readers would be violently opposed to vivisection, and the other half in its favour, so with splendid impartiality he wrote: “Whatever views are held on the question of vivisection, it must be agreed that, if carried out, it must be carried out only by fully qualified practitioners.” There is, of course, no doubt that if these consumer and similar enquiries are undertaken they should be undertaken competently. All sorts of questions arise: How far do the interviewers affect the result? How far does the latitude given to interviewers in selecting the samples affect the results? What are the sampling errors? Do they follow binomial expectation? (The author mentions the probable error. I hope he will abandon that expression and follow the modern convention of using the standard error.) All these are questions which the author has had to ask himself and has had to find some sort of answer, but he has not been able to deal with them very fully in his paper.

Here is a real gap in our statistical knowledge. There is little published information of a quantitative kind on the errors in practical social surveys. The theory of the method of getting observations by the random sample and of assessing their accuracy has been developed very well. But that has problems of mathematical interest which have attracted the attention of mathematicians.

The kind of information I have in mind requires experimental investigation, and one trouble has been that experimentalists in this field are too much interested in the results themselves to give full publication of the methods used and their accuracy. We want a body of people interested in the method for its own sake, and a body of employers enlightened enough to give these people their head. For us in this Society perhaps the most important part of this paper is the reference to the purely methodological studies. The author says that he has not been able to do much in that line because of war conditions. We may hope that when the war is over these studies can take place, and that the results may perhaps be published in our *Journal*. I second the vote of thanks for this paper, in the hope that it is only a first instalment.

The vote of thanks was then put to the Meeting, and carried unanimously.

DR. E. R. BRANSBY said that apparently the investigators made their enquiries in their spare time and were expected to make fourteen interviews per day. Did this mean that they had full-time jobs and did the interviewing at any time which they had at their disposal? Fourteen interviews, if done properly, was a large number, even for a full day's work, and he did not think that one could expect much accuracy if this was a spare-time job. Further, the interviews took place almost anywhere. He felt that this was not really satisfactory. In order to get people to think about their answers and to get the right atmosphere, the interviews should be in the home.

Mr. Silvey had said that the interviewers approached people of their own choice. Such a method of selecting a sample was unsatisfactory, especially as the results were applied to the whole adult population. Considering the smallness of the sample and the method of selection, it was doubtful if much reliance could be put on the results.

It was stated in the paper that the distribution of the population among four types of listeners was based on the "latest available data." It would be interesting to know the nature of these data, for, as far as he was aware, data for breakdowns on a national basis did not, for some characteristics, exist. Even before the war there was not sufficient material to make these breakdowns for the whole population. This aspect was important because it was said in the paper that the social class breakdown was made according to income based on information published in 1938. There had been an enormous change in the income make-up of the population since 1938.

Although the breakdowns were supposed to be made according to "social class," the only factor used for differentiating the social classes was income. The breakdown therefore was not according to social class, but according to income—a big distinction, especially from the point of view of broadcasting. Information on listening habits according to social characteristics would be valuable and interesting. With regard to the point made by Mr. Fieller, in market research work it was not only income which was taken into account, but such factors as general environment, rent, rates, and so on. The details of this classification were given, in *The People's Food*, by Crawford and Broadley.

DR. L. ISSERLIS congratulated the author of the paper on his courage in trying to introduce numerical methods into this difficult subject, but he would probably agree that this was only a beginning and that criteria would have to be developed for making the instruments more precise, the measurements more fine. This brought him to his first point, namely, that one of the things measured was the quantity of listening. He had recently had the experience of being without the use of his eyes, and he listened to the radio with very great intensity from six o'clock in the morning until midnight; he also often listened to the news while shaving, and he did not think this affected the intensity of the listening.

He thought it should be possible to devise some form of control over local correspondents. It should be possible to get an area of potential reactors and have two or more persons as correspondents for that particular area of reaction.

He had colleagues in the Society whom he had known for 20 years, but he would not be capable of reporting on their likes or dislikes in the matter of broadcast programmes, and it was possible that his colleague, the President, and himself would give different reports about the same environment, so that some form of control is necessary.

There was a passing reference in the paper to a possible objective measurement of quantity of listening which had some reference to a meter reading of electrical power consumed, but he was not quite clear whether it was the electrical power consumed by all consumers in a certain area, and provided by an electricity company, or whether it was the electricity used by the B.B.C. in making the broadcast. These were two totally different things. If there was some method by which the B.B.C. could measure what quantity of energy it must emit when programmes were being listened to, that would be a completely objective basis, but if it was a record of the amount of electricity supplied by an electricity company the methods of analysis of variance could be applied to the data.

M. PAUL LÉVY said that he was a professional statistician and a professional broadcaster, and some time before the war he made a study in Belgium similar to that in Mr. Silvey's paper and read it before the Belgian Statistical Society; he was, therefore, greatly interested in Mr. Silvey's paper. Did the B.B.C. have recourse to other methods than those outlined in the paper? A method very much used in America before the war was that of random telephone interviews; another was a direct appeal to listeners to write about one or another definite programme, and the third, perhaps the most interesting, was on the line indicated by Dr. Isserlis, that of studying the consumption curves of radio diffusion at approved centres.

Mr. Moss said that he sympathized with the objects of the paper from many points of view. At the War-time Social Survey they were frequently asked to supply information to Government departments on subjects about which preliminary information could not be found. The paper showed that in one respect that gap was being efficiently filled, and a foundation thus laid for other detailed studies, such as the effect of publicity.

Secondly, published material on consumer needs, apart from material on which research was being made, was very scarce. It was a very good thing that the B.B.C. had allowed this material to be published; the ordinary public would thus have a more reasonable basis for criticism than in the past.

One of the points to be considered in looking at the figures was the composition of the population. The civilian population had varied since the data were first collected, and this must be taken into account in considering the change in listening and the degrees of listening to, for instance, dance music. The changing age of the civilian population must have something to do with the change in taste in this respect. But this was a relatively minor matter when compared with the fact that for the first time a great deal of material was available to those interested in social studies.

A few minor points of criticism concerned the listening panels used to provide the B.B.C. with information about the quality of opinion. The kind of people who would volunteer to operate and serve on such panels were people who had a special interest in doing so. For information about particular kinds of programmes there was good reason for having a panel of people interested in those programmes and getting their views. The use of panels was not so valuable in trying to get the opinion of the general public.

On p. 204 Mr. Silvey spoke about an experiment which had been made in order to throw light on this question. This showed that the people on the panel selected much the same kind of programmes as the ordinary listening public, but that their appetites for these programmes were greater. Mr. Silvey went on to say that because of this there was no reason to suppose that in their estimation of individual broadcasts the same thing did not apply. Mr. Moss found it difficult to accept that. The fact that they were people who listened more than

the general public did mean that they were a special kind of people and their opinion had a different value from that of the ordinary listener. That did not, however, detract from the utility of the panel for other special purposes.

The second point was with regard to the use of local correspondents for giving information about the tastes of the listening public and the kind of questions they were given to ask. It seemed to the speaker that in order to get information which was reliable about the problems mentioned in Mr. Silvey's paper, questions had to be asked. The difficulty was that since Mr. Silvey had not set out to get answers to his questions from a very well-defined section of the population he was confronted with the need to judge who were the people answering the questions. Further, the estimation of the answers was apparently left to the observers. It was not known how many people they had observed or how many they had questioned, nor what questions they had put.

These were points which detracted from the use of local correspondents. There were instances where the use of a direct question was doubtful and some other technique had to be used. He was doubtful about the local correspondents knowing the right way to do it.

The paper stated that the beginning of the building up of the Listener Research Department was in 1936 and it was only in 1941 that the organization was completed. That was a long time, but he did not think it was at all too long for an organization which had to meet such a series of demands. It was important for people using the information derived from such surveys to know that, and they should appreciate the amount of work undertaken in producing these figures. He hoped the Society would have the opportunity of hearing more from Mr. Silvey and having further results made generally available.

MR. MORRELL said that part of his work at the War Office was concerned with Listener Research in the Army (on a much more modest scale, of course, than that conducted by the B.B.C.), and many of his comments on Mr. Silvey's paper were suggested by his own problems and experience.

The first point on which he differed from Mr. Silvey occurred on p. 192, where he said: "This plan aims at a distribution in the sample which will correspond to that in the population under investigation." This seemed at first sight the best course to pursue, but further consideration showed that it was wasteful and unnecessary. It would be sufficient to take an adequate sample of each of the "social classes" and obtain weighted percentages from them. Otherwise, as the upper-middle class was only 5 per cent. of the whole population, either an insufficient sample of this class must be taken or many more of the working class must be examined than was necessary for reasonable accuracy.

Mr. Silvey's method might be justified on two conditions. The first was that separate percentages for each class should not be quoted, in which case there was no need to obtain highly accurate results for the smaller classes, as they would be lightly weighted. But, in fact, separate percentages were quoted. In Table IV percentages were given for each class on samples averaging about 5,200. The average sample for the upper-middle class, therefore, would be about 260, which meant that the standard error of a percentage might be over 3 per cent. and one or more of the percentages quoted might easily be as much as 6 per cent. out. This point might well be overlooked by the casual reader, and such a table should state not only the size of the sample, but the margin of error to be assigned to the various percentages.

Secondly, it was easily shown that the ratios of the various classes in a population would only give the optimum ratios for the sample in special circumstances. Suppose, for instance, there were two classes, a and b in number, and a fixed number of interviews had to be divided between them so as to give the best estimate for the whole population. If σ_1 and σ_2 were the standard deviations of the amount of their daily listening time, the optimum ratio will be not $a : b$ but $a\sigma_1 : b\sigma_2$. In many investigations it was found that standard deviations of the various classes differed considerably, and in this case they might differ greatly in homogeneity. He would be interested to know whether

Mr. Silvey had investigated this point, as the B.B.C. must have many times the necessary amount of data.

The speaker was not quite clear about the classification by income, as it was said in the paper that interviewers classified a person by his occupation, manner, bearing and conversation, and presumably formed a rough assessment of his income from these, which he would have thought most unreliable; also in many occupations a man's income would rise steadily with service and experience, so that there would be a definite correlation of class with age. He would like to have a little more detail about this matter of classification.

On p. 204 a listening panel of housewives was compared with another sample of housewives—namely, those interviewed in the weekly survey. The fact that the two samples had similar opportunities for listening and could listen only at certain times would introduce a spurious correlation, as would also the fact that most people listened to the news bulletins, unless these were excluded from the listening diaries. As the distribution of listening percentages is J-shaped, the correlation coefficient based on them was of doubtful validity, unless some precautions had been taken in selecting the items to overcome this. But even if it was conceded that 0.74 was an accurate coefficient, it only showed that variations in the one sample accounted for 55 per cent. of the variations of the other. To say that their Listening Panel was a good sample of the population of housewives, a much closer fit than this would be required. Furthermore, the χ^2 test would probably be more appropriate than the coefficient of correlation, since the hypothesis was that the two samples were drawn from the same population. He suggested, therefore, that Mr. Silvey's statistics hardly supported his conclusions.

There was a surprising omission from Table II. Light orchestral music was an important part of the B.B.C. programmes, and could not be identified with any item in the table. He suspected a "halo" effect in the item "Religious Services," where 22 per cent. of the population were said to be enthusiastic and 30 per cent. moderately favourable. A similar effect had been found in some of the Forces questionnaires. It was amazing what a high percentage of the Army listened regularly to services and symphony concerts, and it was not easy to obtain reliable figures for such items.

Finally, in any questionnaire there was a vast amount of information that could only be extracted by fairly elaborate technique. His own section frequently obtained extremely interesting results, not only in listener research, but in medical, psychological, and similar surveys, by such methods as factor analysis and multiple correlation. It might be possible, for instance, to measure how far the popularity of the Brains Trust depended on each of the regular members, or to determine the optimum proportions of music, humour, etc., in variety. There was no indication in the paper as to whether anything of this kind was done, and unless it was, it seemed that an immense amount of the information collected by the B.B.C. was wasted. Thorough analysis should yield results of value, not only to Listener Research, but to scientific research generally.

MR. J. GOLDMANN said that one of the regular questions was: "On the whole, are you satisfied or dissatisfied with present B.B.C. programmes?" and Mr. Silvey mentioned that for 80 per cent. of his results the percentage of completely satisfied people was between 45 and 55 per cent., and that, therefore, the distribution of answers was astonishingly inelastic. Now, for a sample of 800 people and with opinion dividing fairly evenly, the standard error was only 1.7 per cent., so that a range of 10 per cent. covered about + - three times the standard of error. If results fell outside these limits, as they did, according to Mr. Silvey, in 20 per cent. of the cases, such variations could not be explained by chance fluctuations of sampling. The explanation might be that the attitude of the public changed. But perhaps there was something wrong with the sampling method, or some difference in selection occurred. If either of the latter were the case, it would be disquieting and should be investigated.

DR. DURANT said that Mr. Moss had pointed out the importance to social scientists as a whole of the publication of Mr. Silvey's paper, which, he thought, was the first occasion on which any of the material gathered by his department had been released to the public. The research into listening habits, opinions and attitudes was a comparatively recent development in this country, and it was exceedingly important that there should be as much public dissection of their methods and results as could possibly be arranged. This view was not popular in some quarters, and for that reason he would emphasize Mr. Moss's remarks.

He had a personal reason for welcoming the paper. He was associated with the British Institute of Public Opinion, which for 3½ years assisted Mr. Silvey and his department in building up the Listener Research, and the survey continued to be made in the same way.

He would like to raise one or two questions. What would happen to the survey of listening after the war when there would be a multiplicity of choice facing the listener? That situation already existed in America, and had not been satisfactorily solved. Many different methods had been employed, all of them open to rather severe criticism. In America a gadget had recently been developed whereby a number of housewives were placed in front of a recorded programme. Each of them was given a dial which recorded their reactions from "Very enthusiastic" to "I hate this."

A very important problem in this research was that of prestige. The research was now carried on by the B.B.C. themselves, who asked, "On the whole, are you satisfied with the programmes of the B.B.C.?" The Institute of Public Opinion went round at the same time asking a very similar question of a very similar sample, and their results showed that 60 per cent. were saying that they were satisfied with the programmes on the whole, while the B.B.C. were finding that 87 per cent. said they were either very satisfied or moderately satisfied with the programmes. This was a considerable difference, and a difference which should be explained. In fairness he should say that Mr. Silvey was well aware of this problem, and was anxious to take steps to try to break it down into its component parts, but at the moment he was unable to do so.

Then there was the further aspect of the problem of prestige which arose when one made any enquiry of this nature into cultural subjects. It had already been mentioned that religious services seemed to have a "halo" round them. Fifty-two per cent. said they were either enthusiastic or moderately enthusiastic about listening to religious services, yet the actual listening audience seemed to be in the region of 10 per cent. The highest figure mentioned was 18 per cent., and it fell to 3 per cent. on other occasions. The same problem was met with in trying to investigate the number of people who read *The Listener*. The circulation was known and an estimate could be made of the number of people who read each copy, but the percentages obtained from actual enquiries showed that four or five times as many people said they read it as could possibly have done so. In all questions where cultural interests were involved extreme care had to be taken of the influence exercised by the question of prestige.

DR. RHODES, who was unable to be present, sent the following comment :—

The B.B.C. is to be congratulated on recognizing the need for the department concerned with listener research. It is admitted that the task of such a department is a difficult one, and it is very easy to criticize adversely the work of such a department and more difficult to give helpful advice. I will concern myself with a few points which occur to me when I look at the tables at the end of the paper.

One of the chief difficulties of statistical tabulation is concerned with the homogeneity or lack of it of the classification of the variables. In Tables II and IV are shown 16 types of programme output. Now, these are very heterogeneous. Variety for instance, as its name implies, has this quality. I do not believe that a great many are enthusiastic towards all variety programmes. Some people, perhaps, like "Itma," but do not listen to "The Old Town Hall." I cannot believe that people will enthuse over "Talks," whatever the subject.

In this same table the listeners are grouped in three classes. Earlier in the

paper Mr. Silvey told us how investigators are asked to describe the persons interviewed according to class. I do not believe that investigators (or anyone else, for that matter) are sufficiently skilled to be able to classify in this way persons whom they meet. If it were possible to divide programme items into homogeneous groups, perhaps we could define social classes by such attributes as "people who listen to a programme type A or B or C."

Another difficulty I have when I read Table IV is concerned with the percentages in the table, which may mean different things when related to various programme items, because apparently there are changes in the number of potential listeners at different times of the day and on different days of the week. This is also noticeable in Table I. In this table the figures for "Happidrome" are higher than those for "Itma," but this difference may merely be due to the first being a Sunday programme and the other a Thursday item. The results would be interesting if Mr. Silvey could construct, for each day of the week and each hour of the day, indices showing the potential listeners.

I have not said anything about the sampling difficulties. These are known to exist. In the future, it may be possible for the B.B.C. to make contact with a fairly large random sample of the population and get from this sample regular reports of listening habits. The kind of research which is now being done is in its early childhood. Some of the methods now used may be dispensed with—e.g., the daily survey of the listening of the day before. I suspect that the research of the future will mainly concentrate on the listening panels.

MR. SILVEY made a brief reply at the Meeting, and amplified it later, as follows :

I am grateful for the friendly reception accorded to this paper and encouraged by the Society's interest in the subject. In my experience, after nearly a decade on the staff of the B.B.C., the occasions when a listener voices a criticism of B.B.C. programmes which has not already been made with greater pungency inside Broadcasting House are very rare indeed. I am reminded of this in re-reading the discussion on my paper. Many, if not all, of the comments which have been made pose, though with greater clarity than I can command, questions which we in Listener Research have asked ourselves repeatedly. Faced with a methodological problem, we have had to estimate the cost, in terms of time and resources, of finding a solution. Not infrequently the price has been beyond our means, especially in war-time conditions. In such cases it sometimes becomes a matter of deciding whether it is better to make use of a less than perfect method, or to abandon a line of enquiry altogether. The decision is never an easy one, but for myself, I am inclined to the view that, other things being equal, it is better to take risks than to play for safety.

It is against this background that I revert to the method of securing the daily sample and the technique of the interview, about which more than one contributor to the discussion expressed misgivings. In one respect it is apparent that my paper conveyed a wrong impression. The use of money incomes for classifying contacts is employed very broadly indeed. Since my paper was read it has, in fact, been dropped altogether. The instructions now given to interviewers read :

"*Social Groups* : These are three in number and are known as A, B, and C, indicating the three broad social classes sometimes called upper middle, lower middle, and working class respectively.

"The A group consists of people such as doctors, company directors, higher civil servants, bank managers, senior business executives, and well-to-do retired people, together with their immediate families. (Only about 5% of the population comes into this group, so they average one interview in every 20.)

"The B group includes most school teachers, office workers, shopkeepers and other small employers, in fact, what are often called 'black-coated workers,' together with their families at home, and people retired from these occupations. (This covers about 20% of the population. i.e., about one interview in every 5.)

"The C group is the largest; it covers 75% of the population so that 7 or 8 out of 10 interviews are with people in this group. It includes the industrial and agricultural wage-earning population, craftsmen or traders working on their own account, and the members of their families living at home. It also includes the vast majority of old age pensioners.

"For Survey purposes a housewife's social group is that of her husband, and the social group of younger members of families living at home is that of their parents. Interviewers must not ask questions, except about occupation, to determine a contact's social group; if necessary they must make their own commonsense judgment based on the contact's manner, bearing and conversation."

I am the first to admit that this method is a crude one. It may well be that a given contact, especially if he is a borderline case, would be differently classified by two interviewers. It may also be, as Mr. Fieller suggests, that an interviewer is tempted to decide the social group of a contact by reference to that contact's listening habits, though this seems unlikely, since the interviewer only knows about the contact's listening on one day. But whatever may be the defects of the method, it cannot, I think, be doubted that the insistence that interviews shall be apportioned among social groups in pre-determined proportions makes for a better coverage of the population than would result from permitting interviewers to choose their contacts without any regard for this characteristic.

Dr. Bransby voiced doubts about the possibility of satisfactory interviews being conducted in the street, and expressed the view that 14 interviews would be a large number even for a full day's work. If the interview were not of the simple factual character that it is, I should be inclined to agree with him. He may, however, rest assured that those who devised the system themselves tested the method by carrying out fieldwork under normal conditions before requiring others to do so. In reply to Mr. Fieller's question about interviewing on Sundays, it is true that the public is less easily accessible on Sundays than on weekdays, but they are not inaccessible. The difficulty is overcome by making, on Sundays, a rather higher proportion of interviews by calls at homes.

Dr. Durant raised a different and important point when he referred to the problem of prestige—that is, the tendency for informants to answer questions in such a way as to make what they think will be a favourable impression upon the interviewer. This tendency is less likely to operate when the interrogation seeks information about behaviour, than when opinions are solicited, because opinions are often loosely held. (My paper refers specifically to this problem in connection with "logging" listening behaviour, and to the steps which are taken by interviewers to guard against the dangers.)

The case which Dr. Durant cited concerns the solicitation of opinion. He called attention to the different results obtained when B.B.C. interviewers, and interviewers of the British Institute of Public Opinion, put to comparable samples the same question, namely: "On the whole, are you satisfied or dissatisfied with current B.B.C. programmes?" A direct comparison of the results obtained by the two organizations is obscured because the B.B.C. classifies those who express an opinion on this question under three heads: "completely satisfied," "moderately satisfied," and "thoroughly dissatisfied." The B.I.P.O., on the other hand, classifies opinions as negative and positive only. Their informants, unless they wish to be recorded as having "no opinion," must choose between answering "yes" or "no." It would be less than honest to suggest, however, that this provides the whole explanation of the difference between the results obtained by the Corporation and the Institute. It is highly probable that even if both organizations classified the answers in the same way, B.B.C. interviewers would tend to secure a somewhat larger proportion giving a reply favourable to the B.B.C. than would interviewers of the B.I.P.O.

The explanation which immediately suggests itself is that the average man is more reluctant to give an unfavourable verdict on the B.B.C. to one of its

own representatives than he would be to make the same reply to an independent party. But this, however true it may be, ignores an important factor, namely the differing circumstances of the Corporation's and the Institute's interviews. The "satisfaction" question is put by B.B.C. interviewers after an interview which is itself evidence to the informant that the B.B.C. takes pains to contact its public. In the course of the interview the informant has cast his eye over a full day's broadcasts and has described his own listening experience. He therefore finds himself answering the "satisfaction" question against a background of fact, however limited. The same question, when asked by the B.I.P.O. interviewers, on the other hand, comes as one of a number of questions on issues of public opinion quite unconnected with broadcasting. Thus, the informant is asked the B.B.C. question without any preliminary warming up. These differing circumstances would not be of importance if the question asked were one upon which the average informant might reasonably be expected to have a firm and decided opinion. To take an obvious case: it can hardly be doubted that were random samples of the British public asked whether they wished to see Japan defeated in this war, the distribution of "yesses" and "noes" would be the same, whatever the circumstances of the interview. But the "satisfaction" question concerns an issue which is not of this character. Opinions on the over-all satisfactoriness of B.B.C. programmes are neither firm nor decided; in many cases, the opinion must be formed, and indeed is known to be formed, on the spot. That being so, the immediate circumstances of the interrogation enter the picture as formative influences.

The answers obtained by B.B.C. interviewers are, therefore, not necessarily either more "true," or less "true," than those obtained by the Institute, and a comparison of them can at best do no more than measure the different results obtained by varying the circumstances under which the same question is asked. In daily practice the problem is largely academic, for it is not the ratio of favourable to unfavourable replies which is potentially illuminating so much as the changes in this ratio when the same question is repeated in similar circumstances day after day. Nevertheless it is well that this problem should be aired, for too often the results of opinion polls are given publicity without the circumstances under which the questions are asked being given adequate consideration.

I must resist the temptation to respond to Mr. Fieller's request that I should deal more extensively with the policy-maker's attitude to listener research. This is not because there is anything to hide, but because it would take me far from my original purpose as expressed in the title of my paper. I can, however, assure him that the Corporation would not have fostered the development of listener research since 1936, nor would it contemplate the very considerable expansion of listener research which is planned for the post-war period, if it had not been satisfied that the department's work paid an adequate dividend in terms of more efficient broadcasting.

I cannot close without expressing appreciation of the various suggestions for further lines of study put forward by Mr. Tippet, Mr. Morrell, Dr. Rhodes, and others. It is my sincere hope that easier times will bring opportunities for following up these suggestions.

As a result of the ballot taken during the Meeting the candidates named below were unanimously elected Fellows of the Society.

Robert Leslie Brown, M.A.
Horace Cotton.
George Henry Ross Goobey, F.I.A.
William Kenneth Gratwick.
Francis William Hindmarsh, B.Com.
Arthur Reginald Kelly, B.Sc.

Fred Martin Lewis.
Frank Mitchell Redington, M.A., F.I.A.
W. F. Searle.
Eric Sharp.
Elizabeth Tanburn, M.Sc., B.A.

Corporate representative

Agnes Mary Kirkus, *representing the Library of the University of Reading.*

MISCELLANEA

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THE SPECIFICATION OF DISTURBED PERIODIC TIME SERIES OF THE TYPE OF
WOLFER'S ANNUAL SUNSPOT NUMBERS

By J. L. SPENCER SMITH, Ph.D.

(*Linen Industry Research Association*)

1. Introduction

In a previous paper¹ the irregularity of textile slivers and yarns was discussed, and it was shown that the most regular yarn which could be obtained by the existing methods of preparation was one in which the fibres were arranged at random along its length. This ideal state is never realized in practice, owing to inevitable imperfections in the design, manufacture, materials, maintenance, or operation of the preparing machinery. In some cases these imperfections may result in a certain periodicity in the yarn thickness, so that its profile presents the form of a disturbed periodic curve, which is frequently very similar in form to that of Wolfer's annual sunspot numbers. The investigation of this type of irregularity in textile yarns led to the examination of the methods of analysing disturbed periodic time series, described below. In order to preserve the general nature of the conclusions obtained, the present paper considers the analysis of the well-known disturbed periodic time series formed by Wolfer's annual sunspot numbers.

The problem that arises is how to specify the series: in general, such a time series is infinite, whereas only a limited portion is available for analysis. The purpose of the analysis is to specify the series as completely as possible and to predict future terms with the greatest accuracy.

The common methods of analysis may be divided into two types:—

- (1) Classical harmonic analysis and its developments.
- (2) Serial correlation or auto-regression methods.

Methods of the first type include Fourier analysis and the various methods of periodogram analysis.² They specify the time series as the resultant of an infinite series of strictly periodic components, and the portion of the time series analysed is specified completely, but only a few of the periodic components can be regarded as persisting throughout the whole time series, the remainder being an analysis of the disturbance or unpredictable portion of the series.

Methods of the second type, which include those of Yule³ and Walker,⁴ specify the series in terms of the regression equations between consecutive terms or sets of terms. Such methods possess the advantage that the distur-

ances are recognized as an integral part of the series, but they have the disadvantage that no distinction is made between the different types of disturbances.

Examination of a disturbed periodic series, of which Wolfer's annual sunspot numbers are a typical example, shows that the series consists of a periodic component of varying amplitude and phase, superposed on a residual trend. It may be regarded as being generated by a periodic function which is disturbed in amplitude, phase and trend.* A full analysis should therefore specify the degree and nature of these three types of disturbance.

The object of the present paper is to analyse Wolfer's sunspot numbers in this manner and to determine how the different types of disturbance affect the usual methods of analysis.

2. Basic equation for a disturbed periodic time series

The most obvious feature of a disturbed periodic time series such as Wolfer's annual sunspot numbers, shown graphically in Fig. 1 (A), is that the phase and amplitude vary. Examination shows that in its simplest form the terms of the series can be represented by the equation:—

$$u_x = (A + \phi_x) \sin \frac{2\pi}{\lambda} (x + v_x) + T + \tau_x \quad . \quad . \quad . \quad (2.1)$$

where: u_x is the value of the term at time x .

A = the mean amplitude of the periodic component.

λ = the mean period length.

ϕ_x = the amplitude disturbance at time x .

v_x = the phase disturbance at time x .

T = the mean value of the terms of the series.

τ_x = the trend disturbance at time x .

If no limitation is placed on the variation of these functions, the above equation can be made to fit any disturbed periodic time series, but if the stipulation be made that the disturbance functions do not contain periodic components, complete generality can only be obtained by adding other similar disturbed periodic terms.

In the case of Wolfer's annual sunspot numbers, Yule (*loc. cit.*) found no evidence of more than one period, so that equation (2.1) may be used. Since all the terms in this series are positive and all the minima are near to zero, it is preferable to use the following form of the equation:—

$$u_x = (A + \phi_x) \{1 + \sin \frac{2\pi}{\lambda} (x + v_x)\} + T + \tau_x \quad . \quad . \quad . \quad (2.2)$$

Obviously there is no unique solution for the disturbance functions ϕ_x , v_x , and τ_x for any given time series. For the purposes of this analysis it is further assumed that each is of the simplest form that enables them to fit the observed values.

3. Consideration of the amplitude, phase and trend disturbances

Before attempting to calculate the disturbances for Wolfer's sunspot numbers, it is necessary to consider the main features of the time series. Yule (*loc. cit.*) demonstrated the strong causal relationship between consecutive

* The distinction between phase and amplitude disturbance is necessary because certain time series, e.g. the diurnal variations in certain phenomena, may be disturbed in amplitude only.

terms of this series, and it is reasonable to assume that they will have a limited continuity. Since the interval of time of a year between the successive terms of the series is purely arbitrary, this limited continuity may be defined as being that the difference Δu_x between the successive terms of the series tends to zero as the interval of time Δx between the terms tends to zero.

In order that the disturbance functions shall be of the simplest form possible, each one must also possess this limited continuity. On the other hand, there is no evidence of any other order in the disturbances, and they must be regarded as having a random trend. In this case they will form a time series of the type described by the author and Todd,¹ which is formed by the resultant of a large number of events which occur at random and whose duration follows a known frequency distribution. These conditions obtain in textile yarns and are likely to occur in the disturbances of such a series as Wolfer's sunspot numbers, atmospheric and similar phenomena. Such a time series possesses the limited type of continuity defined above with a serial correlation coefficient r_s for interval s given by:—

$$r_s = \frac{\int_s x - s) f(x) \cdot F(x) dx}{\int_0^\infty x \cdot f(x) \cdot F(x) dx} \quad \dots \dots \dots (3.1)$$

where $f(x)$ is the chance of an event of duration x and $F(x)$ is the statistical weight given to an event of duration x .

The value of r_s decreases with the interval of time s , but the way in which it decreases depends on the nature of the frequency distribution of x .

Consequently the amplitude disturbance ϕ_x will be given by the auto-regression equation:— *

$$\phi_x = r_s \phi_{x-s} + \epsilon_x \quad \dots \dots \dots (3.2)$$

where r_s decreases from unity as s increases, ϵ_x is a random function. Similar relationships will hold for the phase and trend disturbances.

4. Calculation of the disturbances

The next step is to calculate the amplitude, phase and trend disturbances of Wolfer's sunspot numbers. As pointed out earlier, there is no unique solution for ϕ_x , v_x and τ_x , and therefore an approximate method must be used. Since the amplitude of the periodic component ($A + \phi_x$) and the trend ($T + \tau_x$) possess a limited continuity, their effective values at different times may be obtained approximately by extrapolating values between the successive maxima of the series and similarly between the successive minima. The values so obtained are shown graphically in Fig. 1 (b) and (c). From these and the original time series, the values of the phase disturbance v_x shown in Fig. 1 (d) were calculated. In calculating the phase disturbance an uncertainty of sign is sometimes found, and the value was selected which best preserved the continuity of the time series. Fig. 1 (e) shows some of the terms of the time series constructed by the author and Todd (*loc. cit.*), and it will be seen that all four curves are similar. Whilst it is recognized that this method of analysis is very crude, there can be no doubt that the assumptions made above are justified, and it is worth while continuing with the analysis.

* The general form of the regression equation for ϕ_x is

$$\phi_x = a_1 \phi_{x-1} + a_2 \phi_{x-2} + \dots + a_u \phi_{x-u} + \epsilon_x$$

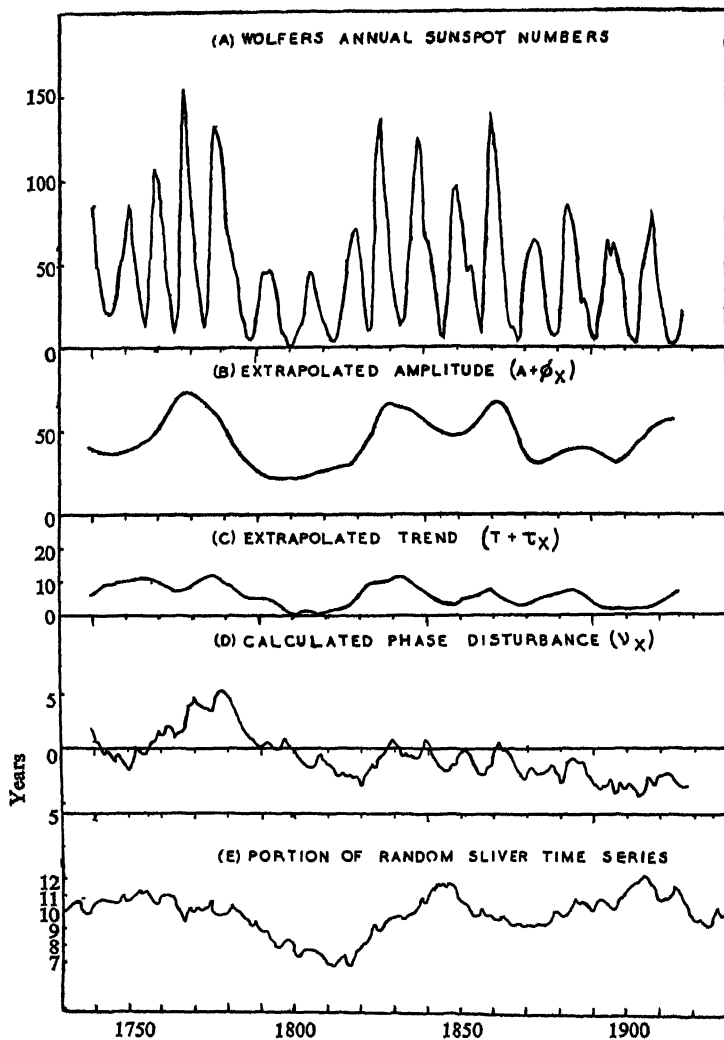


FIG. 1.

The above values for the disturbance functions gave the following values for the constants of the time series:—

- | | |
|---|---------------|
| (1) Mean amplitude of the periodic component A | 43.99 |
| (2) Standard deviation of the amplitude disturbance σ_ϕ | 14.82 |
| (3) Standard deviation of the phase disturbance σ_ν | 2.42 years |
| (4) Mean value of the phase disturbance | - 0.0143 year |
| (5) Mean period length λ | 10.986 years |
| (6) Mean trend T | 5.76 |
| (7) Standard deviation of the trend disturbance σ_τ | 3.39 |

The serial correlation coefficients of the amplitude, phase and trend disturbances are given in Table I.

TABLE I

Serial correlation coefficients of the amplitude, phase and trend disturbances of Wolfer's annual sunspot numbers

Amplitude disturbance		Phase disturbance		Trend disturbance	
Interval, years	Serial correlation coefficient	Interval, years	Serial correlation coefficient	Interval, years	Serial correlation coefficient
0	1.000	0	1.000	0	1.000
1	0.975	1	0.951	1	0.969
2	0.943	2	0.906	2	0.932
3	0.895	3	0.860	4	0.865
4	0.832	5	0.806	6	0.790
6	0.705	10	0.638	10	0.512
8	0.510	15	0.450	14	0.294
10	0.324	20	0.375	20	-0.024
18	-0.067	25	0.162	25	-0.128
24	-0.219	30	0.108	30	-0.268
30	-0.398	40	0.042	40	-0.308
40	-0.655	50	-0.008	50	+0.096
50	-0.472	60	+0.001	60	+0.111
60	0.001			70	+0.002
80	0.360				
100	0.055				

The values of the serial correlation coefficients of the disturbances show that Wolfer's sunspot numbers for consecutive years can be represented by equation (2.1), in which the disturbances ϕ_x , v_x and τ_x are continuous serially correlated time series. The values of the serial correlation coefficient of the phase disturbance for different intervals shows the smooth decay curve, assumed in equation (3.2), whereas the serial correlation coefficients of the amplitude and trend disturbances form damped harmonic series of period lengths of about 80 and 60 years respectively. The significance of these periodicities is very doubtful in view of the manner in which the disturbances were calculated and the fact that only about three independent comparisons are available for determining the high-order serial correlation coefficients, and for the present it seems advisable to ignore them. It is interesting that none of the serial correlograms shows any trace of shorter periodicities, which would show up if there was any periodicity present other than the eleven-year period. This confirms Yule's (*loc. cit.*) conclusion that Wolfer's annual sunspot numbers contain only one periodicity.

5. Application of classical methods of analysis to a disturbed periodic time series

The basic equation developed for a disturbed periodic time series in section (2), and shown to apply to Wolfer's sunspot numbers, enables the Fourier and periodogram coefficients for such time series to be calculated.

Applying Fourier analysis to n periods of a time series $u_1, u_2, \dots, u_n$, etc.,

of the type above, it is found that all the Fourier coefficients tend to zero and give fortuitous results except:—

$$A_\lambda = \frac{2}{n\lambda} \int_0^{n\lambda} u_r \cdot \sin \frac{2\pi x}{\lambda} dx \quad . \quad . \quad . \quad (5.1)$$

where λ is the mean period length.

Filling in the value of u_r from equation (2.1), we have:—

$$\begin{aligned} A_\lambda &= \frac{2}{n\lambda} \int_0^{n\lambda} \left\{ (A + \phi_x) \sin \frac{2\pi}{\lambda} (x + v_x) + T + \tau_x \right\} \sin \frac{2\pi x}{\lambda} dx \\ &= \frac{2}{n\lambda} \left[\int_0^{n\lambda} A \sin^2 \frac{2\pi x}{\lambda} \cdot \cos \frac{2\pi v_x}{\lambda} \cdot dx + \int_0^{n\lambda} A \sin \frac{2\pi x}{\lambda} \cdot \cos \frac{2\pi x}{\lambda} \sin \frac{2\pi v_x}{\lambda} dx \right. \\ &\quad \left. + \int_0^{n\lambda} \left\{ \phi_x \sin \frac{2\pi}{\lambda} (x + v_x) + T + \tau_x \right\} \sin \frac{2\pi x}{\lambda} dx \right]. \end{aligned}$$

Of these, all except the first term will tend to zero as n increases and may be ignored for the purpose of the present analysis. The Fourier coefficient may then be written as:—

$$A_\lambda = A \int_{-\infty}^{+\infty} \cos \frac{2\pi v}{\lambda} \cdot f(v) dv \quad . \quad . \quad . \quad (5.2)$$

where $f(v)$ is the frequency distribution function of the phase disturbance v_x . If v_x is distributed normally with variance σ_v^2 , the expression becomes:—

$$\begin{aligned} A_\lambda &= \text{Real part of } \frac{A}{\sqrt{2\pi}\sigma_v} \int_{-\infty}^{+\infty} e^{-\frac{2\pi i v}{\lambda} - \frac{v^2}{2\sigma_v^2}} dv \\ \text{i.e.,} \quad A_\lambda &= A e^{-\frac{2\pi^2 \sigma_v^2}{\lambda^2}} \quad . \quad . \quad . \quad (5.3) \end{aligned}$$

The same result is obtained for the periodogram coefficient for period length λ .

This result confirms the well-known fact that the classical methods of analysis do not give a true value for the mean amplitude of a phase-disturbed periodic time series, but shows that when only amplitude and trend disturbances are present the true value of A is obtained. It is interesting to note, however, that when the mean amplitude of the periodic component is known or can be found by other methods, the Fourier or periodogram coefficient provides a measure of the phase disturbance of the time series. This may be of importance from the point of view of analysing such time series. The result obtained justifies the assumption made in section (2), that the disturbances may be resolved into different types.

6. Serial correlation coefficients of a disturbed periodic time series

We may now consider the serial correlation coefficients of a time series of the type given in equations (2.1) and (2.2). Representing the terms of the time series by $u_1, u_2, u_3 \dots u_n$, etc., the serial correlation coefficient r_s for interval of time s is given by:—

$$r = \frac{\sum_{\text{all } x} (u_x - \bar{u}) \cdot (u_{x+s} - \bar{u})}{\sqrt{\sum_{\text{all } x} (u_x - \bar{u})^2 \sum_{\text{all } x} (u_{x+s} - \bar{u})^2}} \quad . \quad . \quad . \quad (6.1)$$

where $\bar{u}$ is the mean term value; filling the values of u_x and u_{x+s} and assuming that the time series is stationary, so that $\sum_{\text{all } x} (u_x - \bar{u})^2 = \sum_{\text{all } r} (u_{x+s} - \bar{u})^2$, we have:—

$$r_s = \frac{\sum_{\text{all } x} \left\{ (A + \phi_x) \sin \frac{2\pi}{\lambda} (x + v_x) + \tau_x \right\} \left\{ (A + \phi_{x+s}) \sin \frac{2\pi}{\lambda} (x + s + v_{x+s}) + \tau_{x+s} \right\}}{\sum_{\text{all } x} \left\{ (A + \phi_x) \sin \frac{2\pi}{\lambda} (x + v_x) + \tau_x \right\}^2} \quad (6.2)$$

Assuming that the amplitude, phase and trend are mutually independent* we have:—

$$r_s = \frac{\sum_{\text{all } x} (A^2 + \phi_x \cdot \phi_{x+s}) \cdot \sum \cos \frac{2\pi}{\lambda} (s + z_{s,x}) + \sum \tau_x \cdot \tau_{x+s}}{x_{\max.} \{A^2 + \sigma_\phi^2 + 2\sigma_\tau^2\}}$$

where $z_{s,x} = v_x - v_{x+s}$, since $\sum_{\text{all } x} \cos \frac{2\pi}{\lambda} (2x + s + v_x + v_{x+s}) = 0$

plus a number of cross-products which will tend to zero as the number of observations is increased, and may be neglected for the present, so that

$$r_s = \frac{\frac{1}{x} (A^2 + \alpha_s \sigma_\phi^2) \left\{ \cos \frac{2\pi s}{\lambda} \sum_{\text{all } x} \cos \frac{2\pi}{\lambda} z_{s,x} - \sin \frac{2\pi s}{\lambda} \cdot \sum_{\text{all } x} \sin \frac{2\pi}{\lambda} z_{s,x} \right\} + 2\gamma_s \sigma_\tau^2}{\{A^2 + \sigma_\phi^2 + 2\sigma_\tau^2\}} \quad (6.3)$$

where α_s and γ_s are the serial correlation coefficients of ϕ_x and τ_x for interval of time s .

Further simplification of equation (6.3) depends on the nature of the frequency distribution of $z_{s,x}$. For the present analysis it is assumed that the distributions of v_x and v_{x+s} are normal, so that the distribution of $z_{s,x}$ will also be normal with variance $2(1 - \beta_s)\sigma_v^2$, where β_s is the serial correlation coefficient of v_x for interval s .

Considering the numerator it is found that:—

$$\frac{1}{x} \sum_{\text{all } x} \cos \frac{2\pi}{\lambda} z_{s,x} = e^{-\frac{4\pi^2(1-\beta_s)\sigma_v^2}{\lambda^2}} \quad \text{and} \quad \frac{1}{x} \sum_{\text{all } x} \sin \frac{2\pi}{\lambda} z_{s,x} = 0 \quad (6.3)$$

so that:—

$$r_s = \frac{(A^2 + \alpha_s \sigma_\phi^2) e^{-\frac{4\pi^2(1-\beta_s)\sigma_v^2}{\lambda^2}} \cos \frac{2\pi s}{\lambda} + 2\gamma_s \sigma_\tau^2}{A^2 + \sigma_\phi^2 + 2\sigma_\tau^2} \quad (6.4)$$

Consideration of this result shows that when α_s , β_s and γ_s decrease continuously as s increases, the serial correlation coefficient r_s of the series has the form of a damped harmonic wave superposed on a decay curve, and therefore agrees with the results found in practice for actual time series. The harmonic component of the serial correlation coefficient is free from phase disturbance and therefore enables the period length to be determined accurately.

* Actually there is a correlation of +0.420 between ϕ_x and τ_x , the correlations between v_x and the other two disturbances are not significant. These correlation coefficients might be regarded as coming under the category of nonsense correlations (cf. Yule, *J. Roy. Stat. Soc.*, LXXXIX, 1, 1926). The correlation between ϕ_x and τ_x will introduce a small error into the result given above.

It is interesting to note that when s is large, the serial correlation coefficients α_s , β_s and γ_s will tend to zero, so that:—

$$\lim_{s \rightarrow \infty} r_s = \frac{A^2 e^{-\frac{4\pi^2 \sigma_r^2}{\lambda^2}} \cos \frac{2\pi s}{\lambda}}{A^2 + \sigma_\phi^2 + 2\sigma_\tau^2} \quad (6.5)$$

and from equation (5.3):—

$$A^2 e^{-\frac{4\pi^2 \sigma_r^2}{\lambda^2}} = A_\lambda^2,$$

where A_λ is the Fourier coefficient of the time series for period length λ . This forms an interesting link between the harmonic and correlation methods of analysis.

The relationship between r_s and s does not permit a complete solution of all the constants involved in equation (2.1). It is possible to calculate from it

- (1) the mean period length λ ,
- (2) the mean squared amplitude $A^2 + \sigma_\phi^2$,
- (3) the variance and the serial correlation coefficient of the trend disturbance σ_τ^2 and γ_s .

But it is not possible to separate the amplitude and phase disturbances or their serial correlation coefficients: both cause a damping effect on the harmonic component. Indeed, it would be possible to produce the same relationship between r_s and s for periodic time series which are disturbed only in phase, or only in amplitude, or in varying proportions of both. Consequently the serial correlogram of a disturbed periodic time series does not specify the series completely.

In the case of Wolfer's annual sunspot numbers, with the time series expressed by equation (2.2), the serial correlation coefficient of the series becomes:—

$$r_s = \frac{(A^2 + \alpha_s \sigma_\phi^2) e^{-\frac{4\pi^2}{\lambda^2} (1 - \beta_s) \sigma_r^2} \cos \frac{2\pi s}{\lambda} + 2\alpha_s \sigma_\phi^2 + 2\gamma_s \sigma_\tau^2}{A^2 + 3\sigma_\phi^2 + 2\sigma_\tau^2} \quad (6.6)$$

In this case, if the trend is absent, *i.e.*, if $\sigma_\tau = 0$, the equation can be solved completely in terms of the mean amplitude and period length, A and λ , and the variances and serial correlograms of the amplitude and phase disturbances.

7. Consideration of Yule's Method

Yule (*loc. cit.*) considered the case of a pendulum subjected to random impulses, and showed that the time series thus developed had the regression equation:—

$$u_x = k u_{x-1} - u_{x-2} + \varepsilon_x \quad (7.1)$$

where $k = 2 \cos \frac{2\pi}{\lambda}$ and ε_x is the random disturbance function. When this equation was applied to Wolfer's sunspot numbers the value for the period length came out too low and Yule had to smooth his data in order to obtain good agreement with the actual results. It is interesting to consider Yule's method in terms of the basic equation (2.1). Rearranging equation (7.1) we have:—

$$u_{x-1} + u_{x+1} = k u_x + \varepsilon \quad (7.2)$$

from which to calculate k .

* This follows from the theory of the random sliver (Spencer Smith and Todd (*loc. cit.*)).

serial correlogram of the phase disturbance, and thus enable a complete solution to be made of the equation in terms of equation (2.1).

When trend disturbance is present, insistence upon a regression equation of the form

$$u_{x+1} = ku_x - u_{x-1} + c \quad . \quad . \quad . \quad . \quad . \quad (7.1)$$

means that the terms $\left\{ -2e^{-\frac{4\pi^2(1-\beta_1)\sigma_y^2}{\lambda^2}} \cos \frac{2\pi}{\lambda} + 2\gamma_1 \right\} \tau_r$ must be included in the random term E'_r in equation (7.6). Certainly their mean value is zero, but their presence seems likely to reduce the value of the regression coefficient of u_x , and consequently to reduce still further the value of the period length λ as calculated by this method.

Yule's second method of analysis in terms of the regression equation $u_{x+1} = au_x + bu_{x-1} + c$ has not been investigated, but from general grounds it seems likely that the conclusions would be similar.

8. Possible method of analysis of disturbed periodic time series

The foregoing sections have shown that no present method of periodic analysis is capable of giving a complete solution of any disturbed periodic time series in terms of the basic equation (2.1), nor is the solution possible by a combination of the different methods. The reason for this is that the distinction between the trend and amplitude disturbances is to some extent arbitrary. At the same time it is felt that a complete specification of the time series must distinguish between the two types of disturbance.

At present the only possible method of analysis appears to be to consider the time series in terms of equation (2.2) and to eliminate the trend from the series. A complete solution is then possible in terms of the serial correlation coefficients as described in section (6). This method is particularly suitable for Wolfer's sunspot numbers, since the residual trend in equation (2.2) is small compared to the other terms of the series. The calculation of the residual trend is only approximate, and must be done by the method adopted in section (4), of extrapolating values between the successive minima of the series.

The serial correlation coefficients of the series from which these extrapolated values of the trend have been subtracted are given in Table II. From these values the standard deviation and serial correlation coefficients of the amplitude disturbance σ_δ and α , may then be calculated by eliminating the periodic component of the serial correlogram. This enables the exponential damping factor due to the phase disturbance to be calculated, and hence the standard deviation and serial correlation coefficients of the phase disturbance. The complete analysis is summarized in Table II. It will be seen that the results obtained by this method of analysis are in reasonably good agreement with those obtained in section 4, although there are considerable differences in the serial correlation coefficients.

The conclusion to be drawn from this investigation is that a disturbed periodic time series of the type of Wolfer's annual sunspot numbers can be specified in terms of a periodic component disturbed in amplitude, phase and trend by disturbances which have the form of highly auto-correlated random time series. The present methods of analysis do not permit of a complete solution except by recourse to approximate methods.

TABLE II

Analysis of Wolfer's sunspot numbers

Serial correlation coefficients of Wolfer's sunspot numbers after residual trend has been eliminated

Interval, years	Time series with trend eliminated. Serial correlation coefficient	Amplitude disturbance. Estimated serial correlation coefficient, α_1	$e^{-\frac{4\pi^2}{\lambda^2}(1-\beta_1)\sigma_p^2}$	Phase disturbance. Estimated serial correlation coefficient, β_1
0	1.000	1.000	1.000	1.000
5.5	-0.345	0.70	0.632	0.624
11	0.492	0.50	0.526	0.518
16.5	-0.235	0.42	0.452	0.430
22	0.331	0.27	0.375	0.320
27.5	-0.205	0.04	0.313	0.216
33	0.152	-0.05	0.241	0.056
38.5	-0.153	-0.03	0.216	0.025
44	0.136	-0.02	0.208	0.006
49.5	-0.134	—	0.206	0.002
55	0.140	—	0.205	—
60.5	-0.138	—	0.205	—

Analysis:—

Twice the variance of the time series with trend eliminated $(A + 3\sigma_\phi^2)$	2594
Variance of amplitude disturbance σ_ϕ^2	279.5
Square of amplitude A^2	1756
Amplitude A	41.9
Standard deviation of amplitude disturbance σ_ϕ	16.7
Mean period length λ	11.0 years
Variance of phase disturbance σ_p^2	4.84
Standard deviation of phase disturbance σ_p	2.20 years

Owing to the very high serial correlations of the three disturbances for intervals of a year or two, the basic equation given in section 2 will permit of the prediction of future terms of the time series with greater accuracy than has previously been possible.

In conclusion, I should like to thank the Director and Council of the Linen Industry Research Association for permission to publish these results.

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THE DISTRIBUTION OF WARS IN TIME

By LEWIS F. RICHARDSON

A LIST of "Wars of modern civilization" from 1480 to 1940 A.D. has been published by Quincy Wright (1942, Appendix XX). He states that his list:

"is intended to include all hostilities involving members of the family of nations, whether international, civil, colonial, or imperial, which were recognized as states of war in the legal sense or which involved over 50,000 troops. Some other incidents are included in which hostilities of considerable but lesser magnitude, not recognized at the time as legal states of war, led to important legal results such as the creation or extinction of states, territorial transfers, or changes of government."

As a preliminary to any statistical treatment of Wright's list, a decision had to be made concerning four of the largest wars, namely the Thirty Years War, the French Revolution, the Napoleonic Wars, and the First World War, because Wright lists them both as wholes and as parts. In order to make the wars in the collection less unequal in size, I included all the parts and omitted the wholes, except two wholes which are shown as beginning before any of their named parts. The First World War is thus reckoned as five wars.

Each calendar year can be characterized by the number 0, 1, 2, 3, 4 of wars which began in it, as shown in Appendix I. The number of years of each character has been counted (by three observers, M. W., E. D. R. and L. F. R.) with the following result:

TABLE I
Years from 1500 to 1931 A.D.

Number of outbreaks in the year	0	1	2	3	4	>4	Total
Number of such years ...	223	142	48	15	4	0	432
Poisson law ...	216.2	149.7	51.8	12.0	2.1	0.3	432.1

By the Poisson law is here meant the statement that there were

$$Ne^{-\lambda}\lambda^x/x! \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

years each containing exactly x outbreaks of war. The law was fitted to the observations by first equating N to the observed total number 432 years; and then determining λ by R. A. Fisher's Principle of Maximum Likelihood, according to which λ equals the mean number of outbreaks per year; that is

$$\lambda = 299/432 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

It is seen at a glance that there is a considerable resemblance between the historical facts and the Poisson law. This resemblance suggests that we may perhaps find out something about the causes of wars by thinking of their outbreaks in connection with other phenomena known to be described at least approximately by the Poisson law. Such include: factory accidents, deaths by kick from a horse, and the emission of alpha particles from radioactive substances. In the standard deduction of the Poisson law from the

(p. 357), indicates that we need not further consider the negative binomial. It was otherwise with factory accidents. (Greenwood and Yule, 1920, quoted by Kendall, 1943, pp. 124-126.)

In order to search for other types of deviation from the Poisson law it is desirable to group whole numbers of years together so as to form successive "cells" of equal duration. Let the duration of a cell be τ years. Let there be n consecutive cells.

Then the whole run of years = $n\tau = N$, say (4)

Let $f(x)$ be the observed number of cells which each contained exactly x outbreaks (5)

For example Wright's data can be arranged thus:

TABLE II.
 $n = 144$ cells of $\tau = 3$ years each.

x ...	...	0	1	2	3	4	5	6	7	>7	Total
$f(x)$...	...	18	39	37	29	12	5	2	2	0	144
Poisson ...	...	18.1	37.5	38.9	26.9	14.0	5.8	2.0	0.6	0.2	144.0

The row headed "Poisson" contains the numbers

$$\frac{N}{\tau} e^{-\tau\lambda} (\tau\lambda)^x / x! \quad (6)$$

a formula which can be deduced from (3).

The Method of Maximum Likelihood gives $\tau\lambda = 299/n = 299\tau/432$ for every τ , so that λ automatically comes to the same value $299/432$ whatever cells we take. But the agreement of $f(x)$ with the Poisson law is not automatic, and so is a genuine test. In Table II the agreement again appears good to inspection.

The run of 432 years was chosen because $432 = 3^3 \times 2^4$, and so can be divided into cells of a great variety of durations. For example:

TABLE III
 $n = 8$ cells of $\tau = 54$ years each.

Here $f(x)$ vanishes for all except the following x .

x ...	...	16	31	32	35	42	44	45	54	Total
$f(x)$...	...	1	1	1	1	1	1	1	1	8

In Table III $f(x)$ is no longer a useful conception. It would be more convenient to regard the sample as specified by the eight numbers in the row headed x .

This type of specification can be made general. For any τ let the sample consist of the n numbers

$$(x_1, x_2, x_3 \dots x_n) \quad (7)$$

For $\tau = 1$ many of the 432 numbers coincide; for example, 223 of them are zero; but that causes no unclarity.

A concise test for rejecting a Poisson law.

The χ^2 test cannot be applied to compare the observations in Table III with their Poisson expectations, because all the numbers are small.

In a Poisson population the variance is equal to the mean. This equality is intimately related to rarity or improbability. For the Poisson law is the limit of the term-sequence of the expansion of the binomial $N(p + q)^N$ where $p + q = 1$ as $p \rightarrow 0$ and $Np \rightarrow \lambda$. But for the binomial the mean is Np and the variance Npq . So the equality of the mean and variance of a binomial law, for any k , entails that $q = 1$, $p = 0$; that is zero probability.

These considerations suggest that we should test our observed sample $(x_1, x_2, \dots, x_n)$ by forming the statistic g defined by

$$m = \frac{1}{n} \sum_{i=1}^n x_i, \quad g = \frac{1}{m(n-1)} \sum_{i=1}^n (x_i - m)^2. \quad (8) \quad (9)$$

Then g has the following pleasant properties. All or most of them are known, but a collection may be helpful.

(i) The expectation of g in samples from a Poisson population is unity, for any n (10)

(ii) Provided that the mean m is large (say $m > 5$) the distribution of $(n-1)g$ in samples from a Poisson population is the same as that of χ^2 for $n-1$ degrees of freedom. More explicitly let $L_{\chi^2, n}$ in which the inequality sign appears in the suffix, denote the probability that in samples of n from a Poisson population, g would be greater than its observed value . . . (11)

Then

$$L_{\chi^2, n} = P(\chi^2, n-1) \quad (12)$$

where $\chi^2 = (n-1)g$ and P is the probability for $n-1$ degrees of freedom; given, say, in Fisher's table.

(iii) The χ^2 mentioned in (ii) is appropriate to testing the hypothesis that, apart from chance deviations, the n numbers $x_1, x_2, \dots, x_n$ would all be equal (13)

It is thus quite distinct from the χ^2 applied above to Table I. Both Fisher (1936, p. 60) and Jeffreys (1939, p. 259) mention this special form, namely,

$\chi^2 = \frac{1}{m} \sum_{i=1}^n (x_i - m)^2$ in connection with the Poisson law. The simple hypothesis (13) is certainly consistent with the Poisson law, but can hardly be said to be equivalent to it; for the type of chance deviations is not specified in (13). Yet there is another hidden connection. For the Poisson law, or something approximately equivalent to it, is used in some proofs of $P(\chi^2)$ (e.g., Kendall, 1943, pp. 290-291). The forms and usages of χ^2 are so multifarious that in order to avoid confusion it is desirable to have here a distinctive symbol such as g defined in (9).

(iv) Just where the property (ii) is lacking because the mean m is not large, the gap is made good because in the present data n is then large, and we can prove that for samples from a Poisson population

$$\text{var } g = \frac{2}{n}, \text{ for large } n \quad (14)$$

by the methods in Kendall's (1943) "Advanced Theory of Statistics," Ch. 9.

(v) Jeffreys' test for a deviation from the Poisson law towards the negative binomial is a function of n and g , as he indicates (1939, pp. 258-9).

(vi) There are various simple relations between g and a coefficient Q^2 introduced by Lexis, but variously interpreted by his successors (Keynes, 1921, Ch. XXXII). Lexis included a factor to represent $(1-p)$ in the binomial variance. This factor is purposely omitted from g . Irwin (1932, p. 506-8) explains the relation of Q^2 to one of the χ^2 . Fisher (1936, p. 83) puts Q where the others put Q^2 .

(vii) If the observed g is incredible for a sample of n from a Poisson population then the Poisson law must be rejected. But conversely, if g is credible, all that we can say is that *so far* there is no objection to a Poisson law; a more searching test might still reject it.

Resumed discussion of the distribution of wars among cells of various durations.

In Table III the distribution among cells of 54 years gives $g = 3.56$, $L_{>g} < 0.001$. We must therefore reject both the Poisson law, and the simple law (13) of uniformity apart from chance. Some historical explanation of the departures from uniformity, or at least of their extremes, is therefore required. The 54 year cells that contained most and least outbreaks, extended from 1824 to 1877 A.D. for most, and from 1716 to 1769 A.D. for least.

For the same data arranged as in Table I we have $g = 1.093$ for $n = 432$.

But by (10) and (14) we expect, from a Poisson population, $g = 1 \pm \sqrt{\frac{2}{432}} = 1 \pm 0.068$, the number after the ambiguous sign being the standard deviation. The hypothesis (13) of uniformity-apart-from-chance, and the Poisson law are so far both quite credible for cells of $\tau = 1$ year. We have indeed already verified the Poisson law more thoroughly by a different χ^2 applied to Table I.

How is it that deviations from uniformity-apart-from-chance show so clearly in 54 year cells, but hardly at all in 1 year cells? For much the same reason that the fat and the lean become inconspicuous when the meat is minced.

To push this type of analysis to its extreme in the other direction let us enquire whether wars on the average became more frequent.

TABLE IV
 $n = 2$ cells of $\tau = 216$ years each.

Dates			1500 to 1715 A.D.	1716 to 1931 A.D.
x	...	...	$x_1 = 143$	$x_2 = 156$

Here $g = 0.565$ for one degree of freedom, and so by (12) and Yule's table (Kendall, 1943, p. 444), $L_{>g} = 0.45$.

That is to say *Wright's list indicates an absence of any steady drift towards more or fewer wars* (15)

Cells of some other durations have also been examined by the same tests. The results are collected in the following *summary*.

TABLE V

Distribution of 299 outbreaks of war among the 432 years extending from 1500 A.D. to 1931 A.D. according to Quincy Wright's list.

Number of cells, n	Duration of each cell, τ years	g	$L_{>g}$	Was distribution uniform apart from chance?	Did Poisson law hold?
2	216	0.565	0.45	yes	evidence lacking
4	108	3.29	0.021	unlikely	unlikely
8	54	3.56	< 0.001	no	no
16	27	2.249	0.00 ₈	no	no
48	9	1.538	0.010 *	no	no
144	3	1.058	0.28	yes	yes
432	1	1.093	0.09	credible	yes

* By Wilson and Hilferty's extension of $P(\chi^2)$ tables.

The search for periods differs from the present type of analysis in various respects. To begin with, the former is applied to the sums of the columns, but the latter to the sums of the rows, of a Buys-Ballot table (Kendall, 1945, Art. 3). Nevertheless, a brief allusion to periods may be in place here.

Quincy Wright (1942, Ch. IX) has discussed fluctuations in the intensity of war. He remarks (p. 230) that: "A fifty-year war period has often been noticed." But he does not mention any test of its statistical significance. The need for caution concerning this alleged period has been emphasized by Kendall (1945, Art. 57).

Another collection of wars, defined more objectively

What one person might call a war, another might call a mutiny, or even an incident. The great obstacle to any scientific study of quarrels is contradictory evidence from the opposing sides. Wright's definition of a war involves the notions of its "legality" and "political importance" which are always matters of opinion, and can be permanently controversial. By contrast, the number of persons who died because of the quarrel, although often deliberately mis-stated, is in almost all cases ascertainable by ten years after the end of the fighting within a factor of three times more or less, which is small in comparison with the whole range. The war dead were taken to include all those, on both sides, whether armed personnel or civilians, who were killed fighting, or drowned by enemy action, or who died of wounds or from poison gas, or from starvation in a siege, or from other malicious acts of their enemies. Moreover, deaths from disease or exposure of armed personnel during a campaign were included; but not civilian deaths by epidemic disease in places far distant from the geographical location of the fighting. Before I saw Wright's list I had almost completed a card-index of fatal quarrels classified according as the number of war-dead were of the order of 10^7 or 10^6 or 10^5 or 10^4 . The last group, which is the most numerous, concerns us now. Its precise range is intended to be from 10^3 to 10^4 in war-dead. In popular language it consists of small wars, revolts, insurrections and incidents, in any part of the world, regardless of their legality or their political importance. They were collected from sources too numerous to be specified here, but a list of the dates is set out in Appendix II. Wright's list, which begins in 1480 A.D., has the great merit of being longer than mine, which begins only with 1820 A.D. Where

A.D.		A.D.		A.D.		A.D.		A.D.		A.D.		A.D.	
1482	1	1490	0	98	0	06	0	14	0	22	1	1530	0
83	0	91	0	99	0	07	0	15	1	23	0	31	2
84	0	92	1	1500	0	08	1	16	1	24	1	32	2
85	0	93	0	01	0	09	1	17	0	25	0	33	1
86	0	94	0	02	0	1510	2	18	0	26	1	34	1
87	0	95	1	03	0	11	2	19	0	27	0	35	0
88	0	96	0	04	0	12	1	1520	1	28	0	36	1
89	0	97	0	05	0	13	0	21	2	29	0	37	1

APPENDIX I.—Continued.

A D		A D		A D		A D		A D		A D		A D	
1538	0	96	0	54	2	12	0	1770	2	28	1	86	0
39	0	97	0	55	0	13	0	71	0	29	0	87	0
1540	0	98	2	56	0	14	0	72	0	1830	3	88	0
41	1	99	0	57	2	15	2	73	1	31	3	89	1
42	2	1600	4	58	0	16	1	74	0	32	0	1890	0
43	0	01	0	59	0	17	1	75	2	33	1	91	0
44	1	02	0	1660	0	18	1	76	0	34	0	92	0
45	0	03	1	61	0	19	1	77	1	35	2	93	0
46	1	04	1	62	0	1720	0	78	1	36	1	94	1
47	0	05	1	63	0	21	0	79	0	37	0	95	1
48	0	06	0	64	0	22	0	1780	0	38	1	96	3
49	1	07	0	65	2	23	0	81	0	39	3	97	2
1550	0	08	0	66	2	24	0	82	0	1840	1	98	1
51	1	09	1	67	1	25	0	83	1	41	0	99	1
52	2	1610	1	68	1	26	1	84	0	42	0	1900	1
53	0	11	1	69	0	27	0	85	0	43	0	01	0
54	2	12	0	1670	1	28	0	86	0	44	1	02	1
55	0	13	0	71	0	29	0	87	2	45	0	03	0
56	0	14	0	72	2	1730	0	88	1	46	1	04	1
57	0	15	3	73	1	31	0	89	1	47	0	05	0
58	0	16	0	74	0	32	0	1790	0	48	3	06	1
59	2	17	1	75	1	33	1	91	0	49	1	07	0
1560	0	18	4	76	1	34	0	92	3	1850	1	08	0
61	1	19	0	77	1	35	1	93	1	51	0	09	0
62	1	1620	1	78	1	36	0	94	0	52	1	1910	1
63	0	21	2	79	0	37	0	95	1	53	2	11	1
64	0	22	0	1680	1	38	0	96	0	54	0	12	2
65	1	23	0	81	0	39	1	97	0	55	1	13	0
66	1	24	0	82	2	1740	1	98	2	56	1	14	4
67	2	25	2	83	2	41	0	99	1	57	1	15	1
68	0	26	1	84	0	42	0	1800	0	58	0	16	2
69	2	27	1	85	1	43	0	01	1	59	3	17	1
1570	0	28	0	86	1	44	0	02	2	1860	1	18	0
71	0	29	0	87	0	45	1	03	1	61	1	19	2
72	3	1630	3	88	1	46	0	04	1	62	1	1920	1
73	0	31	0	89	1	47	1	05	1	63	4	21	2
74	0	32	1	1690	0	48	0	06	2	64	1	22	0
75	2	33	0	91	0	49	0	07	2	65	2	23	0
76	1	34	1	92	0	1750	0	08	1	66	3	24	0
77	0	35	1	93	0	51	0	09	1	67	0	25	0
78	0	36	0	94	0	52	0	1810	1	68	1	26	0
79	1	37	1	95	1	53	0	11	0	69	0	27	0
1580	2	38	1	96	0	54	1	12	2	1870	1	28	1
81	0	39	1	97	0	55	0	13	1	71	0	29	0
82	0	1640	2	98	0	56	0	14	0	72	1	1930	0
83	1	41	2	99	0	57	0	15	3	73	1	31	1
84	0	42	0	1700	1	58	0	16	0	74	0	32	0
85	2	43	1	01	1	59	0	17	1	75	0	33	0
86	0	44	1	02	0	1760	0	18	0	76	0	34	0
87	0	45	0	03	1	61	0	19	0	77	1	35	1
88	0	46	2	04	0	62	0	1820	0	78	0	36	1
89	0	47	0	05	1	63	1	21	2	79	3	37	1
1590	1	48	3	06	0	64	0	22	0	1880	1	38	0
91	0	49	1	07	0	65	0	23	2	81	1	39	2
92	0	1650	1	08	0	66	0	24	1	82	2		
93	0	51	0	09	0	67	0	25	1	83	0		
94	1	52	1	1710	1	68	3	26	2	84	1		
95	0	53	0	11	0	69	0	27	0	85	1		

APPENDIX II. *Dates of beginning and ending of fatal quarrels which caused more than 10^3 but fewer than $10^{4.5}$ deaths.*

The columns are arranged in triplets, in each of which the first column contains the date A.D., the second column shows the number of fatal quarrels of the specified magnitude which began, and the third column the number which ended, in that calendar year.

The following list does not, and ought not to, agree with Wright's list; for its definition is different. Many further particulars await publication.

A.D.			A.D.			A.D.			A.D.		
1820	0	0	1850	0	0	1880	0	1	1910	0	1
21	1	0	51	0	0	81	1	1	11	0	0
22	1	0	52	1	1	82	1	0	12	0	0
23	1	0	53	0	1	83	0	1	13	1	1
24	0	1	54	0	0	84	0	0	14	0	0
25	0	0	55	0	0	85	1	2	15	0	0
26	1	3	56	1	0	86	0	0	16	0	0
27	1	2	57	1	0	87	0	0	17	0	0
28	0	0	58	0	1	88	0	0	18	2	1
29	2	0	59	2	1	89	0	0	19	0	0
1830	1	0	1860	0	2	1890	0	0	1920	2	2
31	1	1	61	1	0	91	1	1	21	2	1
32	0	0	62	1	0	92	1	0	22	0	1
33	1	1	63	0	0	93	0	2	23	0	0
34	0	1	64	1	1	94	4	0	24	0	0
35	1	0	65	0	1	95	0	2	25	0	0
36	0	0	66	0	0	96	1	1	26	1	0
37	0	0	67	0	0	97	0	0	27	0	0
38	2	1	68	0	0	98	1	0	28	0	1
39	3	0	69	0	0	99	1	1	29	0	0
1840	0	2	1870	0	0	1900	1	2	1930	0	0
41	1	2	71	1	1	01	0	0	31	0	0
42	0	2	72	1	0	02	0	2	32	0	0
43	1	1	73	0	1	03	0	0	33	0	0
44	0	0	74	0	0	04	0	0	34	0	1
45	1	0	75	2	0	05	0	0	35	1	0
46	1	1	76	0	2	06	1	1	36	1	1
47	0	1	77	1	2	07	0	0	37	0	1
48	1	1	78	3	1	08	0	0			
49	0	1	79	2	1	09	2	1			

THE CONCEPT OF NET VOLUME OF OUTPUT, WITH SPECIAL REFERENCE TO
IRISH DATA

By R. C. GEARY

THEORY is less important than practice in making index-numbers. The main question which arises in connection with the theoretical construction or formula is simply: Does it work? The interesting discussion recently in this *Journal*, in which Mr. H. Leak and Dr. A. L. Bowley participated, and other evidence,* point to improved "quantum-consciousness" on the part of statisticians and economists. The general mood of the present emergency has, of course, contributed to this tendency; so have the great rise and wide dispersion of prices.

In Eire the computation and publication of annual Censuses of Industrial Production have been continued during the emergency. These have latterly been supplemented by a series of quarterly index-numbers of volume. Enquiry extends to all industries producing transportable goods: building, public utilities and other industries of the service type were not included in the years 1939-42, though they have been included in the 1943 enquiry. Net selling value of products (distinguishing principal descriptions) and net cost of materials (also distinguishing principal descriptions) are required to be furnished, together with quantities of both products and principal ingredients, where relevant or practicable. The object of the present paper is to present the results of certain computations, testing on these Irish data the efficacy of the concept of net volume of industrial production, and to attempt to derive guidance, possibly of wider application, therefrom. The value of gross output for each industry shown in columns (2) and (3) of the computational table represents the aggregate of the net selling value of products made, together with receipts for work done on commission in the years in question; the figures in columns (4) and (5) represent the value of purchased ingredients used in the production shown in columns (2) and (3), together with the cost of containers sold with the goods, cost of purchased materials for repairs to firms' own buildings and plant executed by firms' own work-people, payments to other firms for work done, cost of purchased fuel, oils and electricity. The value of products in one total and ingredients in the other, of course, predominate; it should be explained that for the clothing industry, in which commission earnings are substantial, the net selling value of products and cost of materials include the closely estimated value of materials made up on commission.

Net output columns [(6) and (7)] represents the difference between gross output and cost of materials, etc. If over a period there were no changes in prices of final products or materials, it is obvious that net output, as defined, may be regarded as an indicator of industrial efficiency, in conjunction with average personnel or, better, man-hours worked or wage bill deflated by wage

* See appended references.

Computation of Gross and Net Volume of Output

Industries	Actual values						Prices (unit values) in 1912 (1911 = 1)	
	Gross output		Cost of materials, fuel, etc.		Net output		Gross output	Materials, fuel, etc.
	1911	1912	1911	1912	1911	1912		
	(£'000)							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Grain Milling (all mills)	9,580	8,340	8,227	6,978	1,353	1,362	1·102	1·067
Bread and Flour Con- fectionery	5,717	6,490	3,770	4,270	1,947	2,220	1·119	1·112
Creameries	6,137	6,936	5,545	6,377	592	558	1·186	1·215
Bacon Curing	7,864	4,237	7,098	3,489	766	748	1·120	1·057
Sugar (incl. Excise Duty)	3,944	2,148	2,369	1,442	1,575	706	1·036	1·146
Sugar Confectionery ...	3,258	3,842	2,169	2,558	1,089	1,284	1·180	1·190
Aerated and Mineral Waters	442	523	141	180	300	343	1·086	1·344
Malting	1,047	975	832	784	215	191	1·024	1·041
Brewing (incl. Excise Duty)	10,371	10,112	1,756	1,728	8,615	8,384	1·190	1·109
Distilling	454	480	208	217	246	263	1·101	1·137
Tobacco	9,687	10,321	7,921	8,806	1,767	1,515	1·138	1·197
Woolen and Worsted ...	2,133	2,340	1,342	1,424	791	916	1·176	1·175
Linen, Cotton, etc. ...	1,901	1,457	1,241	945	660	513	1·426	1·443
Fellmongery and Leather	1,288	1,552	855	1,101	433	451	1·145	1·156
Hosiery	1,668	1,866	873	953	796	913	1·268	1·103
Clothing:								
Men's and Boys' ...	2,023	2,079	1,266	1,347	757	732	1·334	1·362
Shirtmaking	757	665	546	482	211	183	1·666	1·395
Women's and Girls' ...	1,910	2,176	1,152	1,364	758	812	1·292	1·333
Miscellaneous	535	569	284	299	251	270	1·185	1·299
Boots and Shoes	2,409	2,481	1,348	1,296	1,060	1,185	1·150	1·071
Mines and Quarries ...	493	608	94	110	399	498	1·275	1·080
Timber	1,619	1,565	861	753	758	812	1·104	1·062
Brushes and Brooms ...	166	171	82	87	84	83	1·340	1·370
Metals	1,665	1,408	834	640	832	768	1·236	1·162
Engineering	1,072	1,027	437	419	635	609	1·123	1·216
Vehicles	1,251	786	737	366	514	420	1·287	1·255
Chemicals, Drugs, etc. ...	541	586	279	278	262	308	1·126	1·270
Oils, Paints, etc.	971	1,147	643	753	328	394	1·664	1·813
Soap and Candles	635	886	446	629	189	257	1·501	1·631
Paper-making, etc. ...	1,391	1,229	753	637	638	592	1·367	1·198
Bricks, Pottery, etc. ...	1,441	1,294	755	649	686	644	1·225	1·155
Miscellaneous (incl. Fish Curing, Animal Feed- ing Stuffs, Fertilizers and Butter Factories)	6,558	6,078	4,556	4,246	2,002	1,832	1·125	1·202
Total, above industries...	—	—	—	—	31,509	30,766	—	—

Computational notes: (2) - (4) = (6); (3) - (5) = (7); (10) = (3) ÷ (8); (11) - (16) ÷ 100 = (10) ÷ (2) = (3) ÷ (13); (17) ÷ 100 = (12) ÷ (6); (18) ÷ 100 = (7) -

Certain Industries in Eire in 1942 to Base 1941 = 100

Quantities in 1912 valued at 1911 prices			Quantities in 1911 valued at 1912 prices			Volume index numbers (1911 = 100)				Index number of wage- earners (base, 1911 = 100)
Gross output	Materials, fuel etc	Net output	Gross output	Materials, fuel, etc	Net output	Gross output	Net output			
							Based on 1911 fixed prices	Based on 1912 fixed prices	Definitive	
(L 000)										
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
7,568	6,540	1,028	10,557	8,778	1,779	79.0	76.0	76.6	76.3	85.7
5,800	3,840	1,960	6,397	4,192	2,205	101.4	100.7	100.7	100.7	97.0
5,848	5,249	599	7,278	6,737	541	95.3	101.2	103.1	102.1	100.8
3,783	3,301	482	8,808	7,503	1,305	48.1	62.9	57.3	60.1	85.3
2,073	1,258	815	4,086	2,715	1,371	52.6	51.7	51.5	51.6	93.3
3,256	2,150	1,106	3,844	2,581	1,263	100.0	101.6	101.7	101.6	96.3
482	134	348	480	190	290	109.0	115.7	118.3	117.0	107.1
952	753	199	1,072	866	206	91.0	92.9	93.1	93.0	96.9
8,497	1,558	6,939	12,341	1,947	10,394	81.9	80.5	80.7	80.6	100.4
436	191	245	500	236	264	96.2	99.5	99.8	99.7	115.9
9,069	7,357	1,712	11,024	9,481	1,543	93.6	96.9	98.2	97.5	94.6
1,990	1,212	778	2,508	1,577	931	93.3	98.4	98.4	98.4	103.7
1,022	655	367	2,711	1,791	920	53.7	55.6	55.8	55.7	78.3
1,355	952	403	1,475	988	487	105.2	93.1	92.6	92.9	107.7
1,472	864	608	2,115	963	1,152	88.2	76.4	79.3	77.8	104.4
1,558	989	569	2,699	1,724	975	77.0	75.2	75.1	75.1	91.0
399	346	53	1,261	762	499	52.7	25.1	36.7	30.4	72.9
1,684	1,023	661	2,468	1,536	932	88.2	87.2	87.1	87.1	95.0
480	230	250	634	369	265	89.7	99.4	101.6	100.5	105.2
2,157	1,210	947	2,770	1,444	1,326	89.6	89.3	89.4	89.3	96.8
477	102	375	629	102	527	96.7	94.0	94.5	94.3	124.2
1,418	709	709	1,787	914	873	87.5	93.5	93.0	93.2	106.0
128	64	64	222	112	110	76.8	75.7	75.6	75.7	92.7
1,139	551	588	2,058	969	1,089	68.4	70.7	70.5	70.6	84.3
915	345	570	1,204	531	673	85.4	89.8	90.5	90.1	97.3
611	292	319	1,610	925	685	48.8	62.1	61.3	61.7	83.4
520	219	301	609	354	255	96.2	115.2	121.0	118.1	108.7
689	415	274	1,616	1,166	450	71.0	83.5	87.6	85.5	92.0
590	386	204	953	727	226	92.9	108.1	113.6	110.8	101.5
899	532	367	1,901	902	999	64.7	57.5	59.3	58.4	97.5
1,056	562	494	1,765	872	893	73.3	72.0	72.1	72.0	90.6
5,403	3,532	1,871	7,378	5,476	1,902	82.4	93.5	96.3	94.9	99.5
—	—	26,205	—	—	37,330	81.1	83.2	82.4	82.8	97.0

5) - (9), (12) = (10) - (11); (13) = (2) $\times$ (8), (14) = (4) $\times$ (9); (15) = (13) - (14),
 15), (19) = [(17) $\times$ (18)]^{1/2}.

index.* By analogy, the problem of ascertaining net volume of output is conceived as that of correcting actual net value for price changes in materials and products.

It has been officially estimated that the volume of production of industrial transportable goods in Eire has declined by 17.6 per cent. since 1938. Between 1941 and 1942 the severe fall of 18.2 per cent. was recorded, so that the decline over the whole period was confined to these consecutive years, which, accordingly, are particularly suitable for statistical experimentation.

The volume index as shown in column (16) for *individual* industries reflects *pro rata* the change in volume of *gross* output. The method involves the computation of a price index-number, column (8), between consecutive years, by the Fisher formula, which, divided into the gross value index, gives the volume index. One pauses to observe that this method implies that the price trend for the sometimes substantial total of unpriced items for a particular industry is identical with that for priced items. The alternative assumption would be that the trend in the *volume* of unpriced items was identical with that for priced items; on the whole, the former seems more plausible. The distinction between *price* and *unit value* index-numbers will be borne in mind. Figures here described as price indexes are really unit value index-numbers. This assumes equivalence of units similarly described: necessarily no account is taken of difference in quality. From the quantum index viewpoint the assumption is vitiated by the extent to which *changes* in average quality of a particular description of commodity has taken place. At normal times the change between consecutive years may be assumed to be small: for most commodities there is a great stability in demand and in method of production. Over a longer period the assumption has doubtful validity. On the whole, there is probably a progressive improvement in quality. Even over short periods during the present emergency the assumption of unchanged quality cannot be justified, and recourse must be had to what may be termed "the principle of substitution": the commodities priced are intended for the same market as the former product, which is no longer available to the same specification. It is hoped at a later stage to derive from the wholesale price index-number "true" price index-numbers for industrial products, *i.e.*, index-numbers which will indicate the trend of prices for *identical* qualities of goods, which, when divided into the value index-numbers, will give "true" index-numbers of volume, *i.e.*, an index which would reflect change in quality as well as change in quantity (weight or number). It would be difficult to derive wholesale price index-numbers for materials used, on account of the time-lag factor. In general, however, it is possible that when materials are shown at the censuses in fair detail the unit value price index-numbers will be fairly close to the real trend of prices (quality for quality).

In the official computation the gross volume index-numbers for particular

* In so far, and that is not so far as one would like, as net output can be regarded as a measure of "efficiency." It seems important to draw a distinction between what may perhaps be regarded as the "economic" and "technical" meanings of the term. It is obvious that inferences of a general economic character only can be derived from the kind of data collected at Censuses of Industrial Production. Technical efficiency, on the other hand, will best be measured as the real cost of production of articles exactly specified. It is not necessary here to discuss the defects of net output as a measure of efficiency, particularly in the universal conditions of imperfect competition. The author merely suggests that in a general way the *trend* of efficiency, in the economic sense, can be computed for a given country from detailed and differentiated Census data.

industries are weighted (backwards and forwards) by value of net output to give the quantum index for all industries, the clear intention being that the aggregate index should reflect the trend in the quantum of *net* output. Implicit in the computation is accordingly the assumption that for each industry the percentage change in volume of *gross* output is the same as the change in the volume of *net* output. That this need not necessarily be the case may be seen by considering output in two years in which there has been no appreciable change in prices of either products or materials, in which case no price index-problem arises: values (gross or net) indicate volume. It might happen, however, that the gross output remained the same, but, because the industry (as a whole or a section of it) entered production at a lower stage, the value of materials was reduced, so that net output was increased. In such a case the index of volume of gross output would be 100 (to base previous year = 100), but the volume of net output might be substantially in excess of 100. It is suggested that *both* series of index-numbers should be computed for each industry, the gross index to show the "visible" quantum of goods available, and the net index to show the trend in the amount of work done in the industry. It is also suggested that the aggregate volume of output for all industries together might be based exclusively on the individual net volumes, in the manner shown in the table, in which is included particulars for all those producing transportable goods except two, Printing, publishing, engraving, and Wood furniture, in neither of which the coverage of priced data for products and/or materials is sufficiently extensive.

As already stated, materials include fuel, etc., and packing, etc., as well as ingredients, and for most industries fuel and packing constitute only a small fraction of the total value of materials. In computing the price index-number for these two items it was accordingly assumed that the price change for each was the same for all industries. The two price index-numbers required were computed from certain wholesale price data.

One notes that the index of the volume of output for the 32 industries in the aggregate as computed by the "official" method, namely 81.1 [column (16)], is not significantly different from the figure, namely 82.8 [column (19)], as computed by the method described in the text. For a few individual industries, however, the contrast is very marked: Bacon Curing (48 and 60); Aerated and Mineral Waters (109 and 117); Fellmongery and Leather (105 and 93); Hosiery (88 and 78); Shirtmaking (53 and 30); Miscellaneous Clothing (90 and 101); Vehicles (49 and 62); Chemicals (96 and 118); Oils, Paints, etc. (71 and 86); Soap and Candles (93 and 111). The significance of the net output volume figures is admittedly more difficult to appreciate than the "official" figures in column (16). They may be clearer by reference to the quantum of materials: a net volume index *greater* than a gross volume index indicates a *lesser* materials volume index or increased product *per unit of material*.* It is emphasized that statements of this kind are necessarily made without reference to quality: if a greater quantum product is obtained per unit of material, it *may be* at the expense of quality of product, or the material may itself be of improved quality. Aberrations are also prone to appear through net output being small in relation to value of materials and of products: Creameries, etc., and Bacon Curing are cases in point.

The computational scheme seems consistent by the customary index-number criterion that it behaves for the complex as if there were but a single product and

* See next paragraph.

a single material. If V and v are aggregate values for products and materials respectively (subscripts 0 and 1 indicating earlier and later period respectively), and if P and p are price index-numbers computed using the Irving Fisher formula, the gross (Q) and net volumes (N' or N'') and volume of materials (q) indexes are as follows:—

$$\begin{aligned} Q &= V_1/V_0P \\ \begin{cases} N' = \left(\frac{V_1}{P} - \frac{v_1}{p} \right) / (V_0 - v_0) & \text{(earlier fixed prices)} \\ N'' = (V_1 - v_1) / (V_0P - v_0p) & \text{(later fixed prices)} \end{cases} \\ q &= v_1/v_0p \end{aligned}$$

It is immediate that $Q < N'$ or N'' implies that $Q > q$. The figures N' and N'' are those given in columns (17) and (18) of the table.

From the computational viewpoint the figures for two industries Creameries and Shirtmaking are of particular interest. These two industries are homogeneous in the sense that both products and materials in each are of an undiversified character; nevertheless the figures behave in a peculiar manner. It should be explained that the figures for Creameries as shown are different from those officially compiled (which include particulars for butter, condensed milk and margarine factories, relegated in the table to "Miscellaneous"), in that they relate exclusively to creameries from which even egg-packing (an important ancillary activity of Irish creameries) has been excluded. Nevertheless the gross and net volume figures for this industry differ by no fewer than 7 points, 95 as compared with 102. It is to be inferred that more butter was obtained per gallon of milk in 1942 than in 1941, which is borne out by the fact that it is estimated that in 1941 to make 1 lb. of creamery butter there was required 2.304 gallons of milk: in 1942 the figure was 2.279. These figures differ by only 1 per cent., however, which could be regarded as a better measure of the "improved efficiency" of the industry.* It is obvious that inferences drawn from the latter types of figures are to be preferred to those drawn from net volume; unfortunately there are very few industries in which it can be applied, at any rate from the particulars at present obtained at industrial censuses, which is the reason why recourse must be had to the net volume concept. The reason for the wide divergence (between 7 per cent. and 1 per cent.) is, of course, to be sought in the low proportion borne by net output to value of product in this industry.

This also is a factor in the even more puzzling figures for the Shirtmaking industry, which purport to indicate a substantially larger fall in net than in gross volume, appearing to indicate that, between 1941 and 1942, fewer shirts were obtained per 100 square yards of materials in 1942 than in 1941, whereas the crude yardage figures indicate (as might be expected) just the contrary result: 29.9 square yards per dozen shirts in 1941 as compared with 29.0 for 1942. From columns (8) and (9) it will be observed that prices of products advanced far more than prices of materials, contrary to the usual experience.

In the great majority of cases the figures in columns (17) and (18) are satisfactorily close together: Shirtmaking, Chemicals, etc., and Soap and Candles are the only industries in which the divergence is appreciable. Certain experiments were carried out with a view to ascertaining the relative degree of divergence of the method used compared with a method whereby the quanta of

* For this particular industry it would, of course, be more correct to interpret the result as due to improved quality in materials, *i.e.*, butter fat content per gallon of milk.

materials and products in (i) 1941 and (ii) 1942 were literally valued at 1941 and 1942 prices (with an adjustment for unpriced items). In general the second method gave much more divergent results (*e.g.*, the two net output figures for Aerated and Mineral waters were 116.0 and 118.3 by the first method, compared, with 111.4 and 127.1 by the alternative method, though this was possibly an exceptional case) because, of course, there entered (implicitly) into its computation *four* price index-numbers, two for materials and two for products, as compared with *two* for the method of the table.

The final column shows the index-numbers of average number of wage-earners, which, in normal times, would be relevant to the study of the net volume trend. The comparison is vitiated during the present period by the fact that the Irish Government has deliberately framed its price-control policy with a view to maintaining the maximum employment, so that, in the aggregate, while net output volume has declined by 17 per cent., employment has declined by only 3 per cent. Incidentally, it should be observed that the aggregate index of 97 is computed, not as the index of the change in employment in the aggregate of all the industries, but as the mean of two figures, both computed by weighting the index-numbers for the individual industries by the net output using (i) net value of output in 1941 and (ii) net value of output in 1942: it is suggested, in fact, that for the purpose of computing indexes of efficiency * for large industrial groups, or for all industries together, employment figures for individual industries should, in principle, be weighted by net output, *i.e.*, as in the case of quantum indexes.

Certain computational experiments have also been made with the gross and net volume of agricultural production with the results indicated in the following table:—

Estimates by different method of gross and net output volume index numbers for Agriculture

(Base 1938-39 = 100)

	Agricultural year				
	1938-39	1939-40	1940-41	1941-42	1942-43
Gross output volume:					
(1) New series—using fixed (1938-39) prices	100	103.7	97.5	100.6	94.2
(2) New series—using Fisher formula	100	102.6	96.7	99.1	93.0
(3) Official figures *—using fixed (1929-30) prices	100	103.4	96.3	99.8	92.1
Net output volume:					
(1) Using fixed (1938-39) prices	100	102.5	98.5	112.5	108.9
(2) Using Fisher formula	100	102.0	99.2	116.1	112.6

* With base changed from 1929-30 to 1938-39.

The value of the gross output of agriculture represents the value, at prices which farmers receive, of the estimated quantities of products sold off farms or products consumed in farm households without process of sale; the value of

* *E.g.*, net output volume per man hour worked, machinery hours per man hour, etc.

net output represents the difference between the value of gross output and the cost of animal feeding-stuffs, fertilisers and seeds purchased by the agricultural community as a whole, *i.e.*, excluding inter-farm transactions. An important distinction between the definition of gross output in the case of agriculture and industry will be noted at once: there is no duplication in the concept for agriculture, whereas in the total for all industries, and even in the total for particular industries, there may be duplication, since the product of one industry may be an ingredient for another. In the case of agriculture the concepts of both gross and net output have great importance; in the case of industry the net output, or the increment created by the manufacturing process, has incomparably the greater significance.

The three series for gross output yield very similar results, though one would have wished the figures at (1) and (3) to be closer in 1942-43. Still, it is reassuring that the official figure is quite close to series (2).

The value of materials purchased by the agricultural community as a whole normally constitutes only a small fraction (about one-sixth) of the value of output, so that at normal times the trend in the gross output was very similar to that of the net output. With the great shortage of animal feeding-stuffs and fertilizers during the emergency there has occurred a sharp decline in the value of materials purchased from £8,698,000 in 1938-39 to £2,596,000 in 1942-43. On account of the increase in prices, the fall in quantum of materials was even much greater than these figures indicate. In these circumstances it becomes clear at once that, while the gross volume of output is an indication of the amount of agricultural production available for home consumption or export, its trend cannot correctly reflect the quantum increase in agricultural effort since pre-war.

The simplest method of assessing the trend in the volume of net output would be to value products and materials at fixed prices. For net output series (1) 1938-39 values have been used. Net output series (2) was found by computing price index-numbers (as the geometric mean of figures computed from "back" and "forward" weights) for products and materials separately; the computation was completed in a manner identical with that used above for industrial net output.

The table shows that between 1940-41 and 1941-42 the figures at (1) and (2) tend to diverge. In 1942-43 the "Fixed Prices" index is nearly four points less than the value found using the Fisher formula. The divergence must be regarded as an arithmetical phenomenon due primarily to the marked fall in the volume of materials used. Furthermore, as in the case of industry, the necessity of using two price index-numbers in its computation renders the net figures more unstable than the gross output estimates in which only one price index is (implicitly) used.

Tentative conclusions to this enquiry are as follows:—

(1) The net output volume, as defined, is likely to be more unstable arithmetically than the gross output volume because of (a) the intervention in its computation of two price index numbers namely those of materials and of products, and (b) net output, often being only a small fraction of the net selling value of the product, has to bear the brunt of arithmetical aberrations in the larger figures representing values of materials and products.

(2) In all cases industries should be classified into as homogeneous groups as practicable for net output volume analysis. (One would have

liked to have subclassified this Irish data but in certain important cases this would have involved the disclosure of the affairs of large individual concerns.) As an illustration, it may be stated that the figures in columns (16) and (19), for the composite official group "Creameries, butter factories, condensed milk and margarine," were 92.6 and 113.6, much more divergent than the figures 95.3 and 102.1 shown in the table for creameries alone.

(3) It would be unfair to the method to take too pessimistic a view of its possibilities on the present experience. On the whole the experiment has shown that the concept of net output volume is likely to be effective in normal times.

It is a pleasure to acknowledge my thanks to Mr. Stanley Lyon, Director of Statistics, for helpful advice and criticism, to Mr. A. S. O'Coineain, M.Sc., B.A., for technical assistance and to other colleagues in the Statistics Branch, Department of Industry and Commerce, Dublin, for computational work.

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NOTE ON DR. GEARY'S PAPER

The paper by Dr. Geary on "The Concept of Net Volume of Output" achieves some very interesting results and is a step forward in the clarification of current ideas on the subject of index-numbers of the volume of production. There are, however, certain points implicit in Dr. Geary's analysis which need rather closer examination:—

1. *The effect of duplication* is hinted at when Dr. Geary discusses the influence of a change in the stage at which firms in an industry enter production. Clearly, if the amount of duplication within an industry alters, the relationship between the volumes of net and gross output is correspondingly changed. The figures for the shirtmaking industry, however, appear to indicate that less work was done on the material, rather than that fewer shirts were obtained from the same materials, as Dr. Geary assumes. So far as the United Kingdom is concerned, it is well known that the austerity scheme for clothing was devised to secure that less labour is expended on the manufacture than was normal. Dr. Geary appears to be on doubtful ground when comparing the square yardage of material used per dozen shirts, since the materials purchased include a large quantity of rayon which cannot be matched precisely (from the published data at any rate) with the output, since this includes pyjamas as well as shirts.

There is, however, a further effect arising from duplication within an industry: the volume of net output, as computed by Dr. Geary, will be altered *if the price movements assumed for duplicated gross output and for duplicated materials are different*. This will normally happen whenever the duplicated output and materials are not recorded in the requisite amount of detail. The result can

also be complicated by a change in the amount of duplication from one Census year to the next. Using Dr. Geary's notation, and taking d_0 and d_1 as the value of duplication in the first and second Census years, respectively, the volume of net output free from duplication on the basis of Fisher's "ideal" formula becomes:—

$$N = \sqrt{\frac{V_1 - v_1}{V_0 - v_0} \cdot \frac{\left(\frac{V_1}{P} - \frac{v_1}{p}\right) + \left(\frac{d_1}{p} - \frac{d_1}{P}\right)}{\left(\frac{V_0}{P} - \frac{v_0}{p}\right) + \left(\frac{d_0}{p} - \frac{d_0}{P}\right)}}$$

We have assumed that the duplicated output is revalued, in effect, on the overall price index-numbers for gross output and for materials purchased. The volume of net output is then unaffected by duplication *only when* $p = P$, and $N \geq \sqrt{N'N''}$, according as $P \geq p$. Further, the extent of the divergence between N and $\sqrt{N'N''}$ depends also on the relative sizes of d_0 and d_1 .

Taking the figures given by Dr. Geary for the shirtmaking industry in Eire as an example, we find that between 1941 and 1942 the prices of materials rose by only 39.5 per cent., compared with 66.6 per cent. for gross output. The year 1942 was one of great changes in the volume of production in Eire, and there may well have been a significant reduction in the amount of duplication in Irish industry in that year. The Concentration of Industry scheme in the United Kingdom has led to the temporary elimination of many firms in the consumer-goods industries, thus reducing the amount of sale between manufacturers in the same industry. Assuming for the sake of argument that the duplication for the shirtmaking industry (which affects equally the value of materials and of gross output) was £50,000 in 1941 but only £20,000 in 1942, these being arbitrary figures to illustrate the point, the volume calculation can be re-worked, by Dr. Geary's method, to yield index numbers free from duplication, and these, together with the ones given by Dr. Geary, are shown below:—

Volume of production (1941 = 100)

Item				Including duplication	Excluding duplication
Gross output	...	...	...	52.7	54.7
Net output:					
At 1941 prices	...	...	...	25.1	26.5
At 1942 prices	...	...	...	36.7	37.7
Geometric mean	...	...	...	30.4	31.6

As was to be expected, the new index for the volume of gross output is higher than the old, now that the duplication assumed to exist has been eliminated; but the volume of net output has thereby also been increased by about the same proportion as the gross output. It should be pointed out that duplication has, for this example, been assumed at a very small proportion of gross output; in many trades duplication is very much more important, and the effect of changes in duplication may be greatly enhanced if this occurs simultaneously with a variation in the price index-numbers of gross output and materials.

The apparent arbitrariness thereby introduced into the calculation of the volume of net output can be overcome only by introducing detailed headings for the duplicated output in both the Materials and the Output tables. In this way, the unit value index for each item of duplicated output should be approxi-

mately the same as that for the duplicated materials, except where merchanting is important. In the United Kingdom Census of Production, 1935, a reasonably correct volume of net output can be calculated only for those trades for which fairly complete particulars were obtained as to the different kinds of materials purchased.

2. *The influence of stock valuation on net output.* The usual practice at a Census of Production is to ask for output during the year of return as represented by sales during the year *plus* the value of stocks at the end of the year *less* the value of stocks at the beginning of the year. The Irish Census Reports define gross output as the "net selling value of all goods produced during the year, whether sold or added to stock." In practice, many Census schedules would almost certainly be completed by accountants on the basis of the usual formula as given above. The same procedure applies, of course, to the cost of materials.

When prices of gross output and of materials are changing rapidly, and at different rates, the values recorded distort the real movements by different extents, and accordingly the residue assumed to be net output will not truly reflect the productive activity in any industry. The volume index-numbers for gross and net output presented by Dr. Geary may well be significantly disturbed by this factor. When prices fall rapidly, as they did in 1930, the value of net output (from which the volume would be calculated) was greatly affected by this factor in a number of industries in the United Kingdom. The only method of overcoming this distorting influence is to collect particulars at the Census in respect of the quantities of the principal descriptions of stocks held at the beginning and end of the year; allowance can then be made for the change in physical quantities of stocks, and the true value of net output arrived at.

3. *The use of an index of wholesale prices in the calculation of the volume of output from Census data.* This method is, in practice, an unreliable one, since an index of wholesale prices can cover only a part of the field covered by an individual Census heading. Moreover, it is relatively more easy to obtain price quotations for less highly fabricated goods than for complex products, since the latter have a great variety of components, any or all of which may be changed from one year to the next. A wholesale price index, while it may accurately reflect the price movement of the items it covers, does not necessarily relate to a Census of Production heading. It seems better to try to improve and amplify the Census classification, thereby making individual headings correspond more closely with individual types of commodities; the resulting index-numbers of unit values should then approximate to price indices, and though this method leaves quality changes out of account, it appears to involve less likelihood of error than that put forward by Dr. Geary. The real point to appreciate in dealing with volume calculations for production statistics is that the data cannot yield a really accurate result, whatever means are used, and a price index applied to the Census value figures only introduces a further possible cause of uncertainty. When he comes to consider the same problem in connection with materials, Dr. Geary in fact discards his "wholesale price index" scheme in favour of improving the Census classification.*

H. LEAK.

A. MAIZELS.

* For Dr. Geary's reply to these comments see p. 290.

WHOLESALE PRICES IN 1943
BY THE EDITOR OF "THE STATIST"

(*The Statist's* Index Numbers in continuation of
Mr. A. Sauerbeck's figures)

The Editor of *The Statist* greatly regrets that, owing to pressure of work on a depleted staff, he has not this year been able to furnish in time the customary textual comment upon Wholesale Prices Statistical Tables.

TABLE I

THE STATIST'S *Annual Index Numbers* (in continuation of *Sauerbeck's figures*)
(1867-77 = 100)

Year	Average No.	Year	Average No.	Year	Average No.	Year	Average No.	Year	Average No.
1943	155	1923	128	1903	69	1883	82	1863	103
'42	151	'22	131	'02	69	'82	84	'62	101
'41	142	'21	155	'01	70	'81	85	'61	98
'40	128	'20	251	'00	75	'80	88	'60	99
'39	94	'19	206	1899	68	'79	83	'59	94
'38	90	'18	192	'98	64	'78	87	'58	91
'37	102	'17	175	'97	62	'77	94	'57	105
'36	88	'16	136	'96	61	'76	95	'56	101
'35	83	'15	108	'95	62	'75	96	'55	101
'34	81	'14	85	'94	63	'74	102	'54	102
'33	78	'13	85	'93	68	'73	111	'53	95
'32	79	'12	85	'92	68	'72	109	'52	78
'31	82	'11	80	'91	72	'71	100	'51	75
'30	96	'10	78	'90	72	'70	96	'50	77
'29	114	'09	74	'89	72	'69	98	'49	74
'28	119	'08	73	'88	70	'68	99	'48	78
'27	122	'07	80	'87	68	'67	100	'47	95
'26	125	'06	77	'86	69	'66	102	'46	89
'25	136	'05	72	'85	72	'65	101	'18	159 *
'24	139	'04	70	'84	76	'64	105	'10	171 *

* Jevons' numbers adjusted.

TABLE II

THE STATIST'S *Annual Index Numbers—ten-year averages* (1867-77)

1838-1847 = 93	1901-1910 = 73	1918-1927 = 159
'48-'57 = 89	'02-'11 = 74	'19-'28 = 152
'58-'67 = 99	'03-'12 = 76	'20-'29 = 142
'68-'77 = 100	'04-'13 = 77	'21-'30 = 127
'78-'87 = 79	'05-'14 = 79	'22-'31 = 120
'88-'97 = 67	'06-'15 = 82	'23-'32 = 115
'90-'99 = 66	'07-'16 = 88	'24-'33 = 110
'91-1900 = 66	'08-'17 = 98	'25-'34 = 104
'92-'01 = 66	'09-'18 = 110	'26-'35 = 99
'93-'02 = 66	'10-'19 = 123	'27-'36 = 95
'94-'03 = 66	'11-'20 = 146	'28-'37 = 93
'95-'04 = 67	'12-'21 = 148	'29-'38 = 90
'96-'05 = 68	'13-'22 = 153	'30-'39 = 88
'97-'06 = 70	'14-'23 = 157	'31-'40 = 91
'98-'07 = 71	'15-'24 = 162	'32-'41 = 97
'99-'08 = 72	'16-'25 = 165	'33-'42 = 104
1900-'09 = 73	'17-'26 = 164	'34-'43 = 111

Monthly Fluctuations of the Index Numbers* of 45 Commodities, 1867-77 = 100

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1898	62.8	63.4	63.0	65.5	66.4	64.7	64.3	64.0	63.9	63.6	63.9	63.8	64
1899	65.4	65.8	65.6	66.1	66.6	66.9	67.9	68.3	70.0	71.5	71.6	72.3	68
1900	74.0	75.1	75.7	75.6	75.5	75.7	76.2	76.0	75.5	74.7	73.9	73.4	75
'01	72.2	71.7	71.0	70.6	70.5	69.8	69.5	69.8	69.6	69.6	69.0	68.4	70
'02	68.8	68.9	69.2	69.7	70.9	70.4	70.0	69.5	69.3	68.8	68.6	69.1	69
'03	69.5	70.2	70.4	69.4	69.6	69.5	69.5	70.0	69.1	69.0	69.0	70.0	69
1904	70.4	70.8	70.8	70.5	69.9	69.4	69.9	70.4	70.7	71.0	71.2	70.9	70
'05	71.2	71.4	71.8	72.0	71.7	72.0	72.5	72.3	72.4	73.2	74.2	74.9	72
'06	75.2	75.0	75.7	76.5	77.0	76.9	76.4	76.7	77.5	78.5	78.6	79.7	77
'07	80.0	80.7	80.0	80.7	82.4	82.0	81.1	79.4	79.1	78.8	76.7	76.2	80
'08	76.0	74.5	74.1	73.8	73.6	72.9	73.1	72.2	72.5	72.2	72.2	72.3	73
1909	72.0	71.9	72.4	74.3	75.4	75.1	75.2	74.9	74.7	75.2	75.5	76.3	74
'10	77.1	78.1	79.1	78.5	78.2	76.9	78.1	78.2	77.6	77.2	77.8	77.9	78
'11	78.5	78.6	78.9	80.0	80.3	80.0	78.9	79.5	80.3	80.7	80.6	80.9	80
'12	81.8	82.9	84.4	85.0	85.3	85.5	86.5	85.9	86.7	85.8	85.3	86.4	85
'13	86.4	86.1	86.7	86.2	85.7	84.1	84.2	85.0	85.7	84.5	83.3	83.8	85
1914	83.5	83.8	82.8	82.3	82.3	81.2	82.4	87.9	89.3	89.8	88.8	91.6	85
'15	96.4	100.9	103.7	105.9	107.2	106.4	106.4	107.0	107.8	110.0	113.1	118.4	108
'16	123.6	127.0	130.4	134.2	135.4	131.0	130.5	134.5	134.4	141.5	150.8	154.3	136
'17	159.3	164.0	169.0	173.0	175.0	180.4	176.9	175.7	176.4	180.6	182.9	185.1	175
'18	186.2	187.3	188.0	189.8	191.1	192.3	192.9	195.9	197.1	197.8	195.3	196.0	192
1919	192.1	187.5	184.7	184.6	194.6	199.4	206.4	212.7	214.8	224.3	231.0	235.2	206
'20	245.3	260.4	261.8	266.1	260.0	255.7	254.6	253.5	243.7	239.9	223.8	207.2	251
'21	197.7	183.0	177.2	169.8	162.2	155.8	158.2	154.3	149.4	138.4	136.7	133.6	165
'22	132.5	132.2	133.3	134.8	135.5	135.6	134.0	129.6	127.9	130.1	130.6	129.1	131
'23	130.2	131.9	132.7	134.0	132.2	127.9	124.8	125.0	127.8	127.7	132.4	133.2	128
1924	137.2	138.8	137.0	136.8	136.4	136.3	138.4	138.0	141.3	146.1	145.5	147.7	139
'25	144.8	143.1	140.1	137.5	135.7	131.2	134.3	134.3	132.7	130.2	132.9	130.4	136
'26	129.3	127.9	126.1	125.5	125.7	124.9	126.0	127.0	128.0	131.0	130.8	123.9	125
'27	123.1	124.1	123.6	123.3	123.8	123.1	122.0	122.8	121.5	120.6	121.5	121.4	122
'28	120.9	121.1	123.6	125.6	126.2	122.6	120.3	118.0	116.8	116.8	117.9	117.9	119
1929	117.0	120.1	120.5	116.5	113.0	113.1	115.2	113.9	112.6	111.1	108.3	108.8	114
'30	106.6	104.8	103.0	101.5	98.8	95.8	94.4	92.2	90.8	90.4	88.6	86.9	96
'31	85.7	85.5	85.5	84.4	82.2	82.6	80.2	79.1	80.7	82.3	83.0	85.4	82
'32	84.7	86.7	84.1	82.5	80.2	77.0	78.9	80.7	80.4	77.8	77.9	77.7	79
'33	77.8	77.0	77.0	82.5	80.0	81.3	81.7	81.2	80.7	80.5	79.3	80.0	78
1934	82.5	82.5	82.2	81.0	81.1	80.7	82.4	83.4	82.1	81.1	81.0	82.8	81
'35	83.6	83.4	82.9	84.1	85.2	83.7	84.3	84.1	85.1	85.8	86.3	86.7	83
'36	87.1	87.1	86.7	86.2	85.6	84.8	87.1	89.0	90.4	91.7	94.5	98.9	88
'37	99.6	102.1	107.3	104.7	106.2	104.7	105.9	104.4	103.3	100.8	96.7	97.3	102
'38	90.5	96.4	94.2	93.5	91.4	91.4	91.1	88.6	88.6	88.8	87.4	89.1	90
1939	88.7	88.6	89.0	90.5	90.6	90.6	88.7	90.4	99.7	105.8	112.2	120.1	94
'40	124.1	124.5	123.4	126.0	128.0	130.0	129.5	131.5	131.6	131.8	132.7	134.5	128
'41	134.9	136.3	138.0	141.1	143.5	144.4	145.3	145.1	145.5	143.7	145.5	146.5	142
'42	148.6	153.4	153.5	154.5	156.6	154.4	150.0	149.4	149.7	150.4	151.3	152.2	151
'43	153.3	153.2	154.0	154.9	155.6	155.4	156.0	154.4	154.6	153.7	153.9	153.9	155
1944	154.9	155.1	155.7	157.9	159.5	160.0	161.9	161.5	160.1	159.6	160.3		

* The average of the twelve monthly figures of each year does not necessarily coincide with the annual figures, as the latter are calculated mostly from the average of 52 weekly quotations, while the former are based on end-of-the-month prices.

Summary of Index Numbers. Groups of Articles, 1867-77 = 100

	Vegetable Food (Corn, etc.)	Animal Food (Meat, etc.)	Sugar, Coffee, and Tea	Total Food	Minerals	Textiles	Sundry Materials	Total Materials	Grand Total	Silver *	Wheat Harvest †	Average Price of Consols ‡	Average Bank of England Rate ‡
1873.....	106	109	106	107	141	103	106	114	111	97.4	80	92½	Percent. 4.750
1896.....	53	73	59	62	63	54	63	60	61	50.5	112	110½	2.483
1911.....	70	90	61	75	93	76	81	83	80	40.4	110	79½	3.467
1917.....	177	192	113	169	172	192	174	179	175	65.8	102	54½	5.15
'18.....	168	207	130	174	192	222	202	206	192	76.4	111	56½	5.0
'19.....	179	213	147	185	220	228	219	222	206	85.3	98	54½	5.166
'20.....	227	263	198	234	295	262	244	264	251	76.1	96	47½	6.71
'21.....	143	218	83	158	181	140	145	153	155	48.1	118	47½	6.092
1922.....	107	184	82	130	142	134	122	131	131	51.6	105	50½	3.692
'23.....	98	162	101	122	155	140	115	133	128	49.4	105	57½	3.496
'24.....	119	158	105	130	158	170	119	145	139	50.7	107	56½	4.0
'25.....	118	162	89	128	154	165	117	142	136	52.5	114	56½	4.575
'26.....	108	150	88	119	154	133	112	130	125	47.1	99	54½	5.0
1927.....	108	138	83	114	141	131	116	127	122	42.8	109	54½	4.650
'28.....	107	142	78	114	123	136	114	123	119	44.0	109	55½	4.5
'29.....	99	146	72	110	126	122	108	117	114	40.2	114	54½	5.508
'30.....	77	142	54	96	112	84	94	96	96	20.0	99	56	3.4
'31.....	68	119	50	83	100	63	81	80	82	20.4	99	55½	3.975
1932.....	72	105	50	79	99	64	78	80	79	19.5	105	66½	3.017
'33.....	60	106	47	74	107	67	76	82	78	18.7	114	73½	2.0
'34.....	63	108	50	77	109	72	76	84	81	20.0	120	80½	2.0
'35.....	66	107	42	76	112	80	79	88	83	26.4	112	86½	2.0
'36.....	76	109	41	81	118	83	84	93	88	18.5	100	85½	2.0
1937.....	93	117	49	93	142	93	98	109	102	18.4	99	76½	2.0
'38.....	81	111	43	84	136	75	83	95	90	17.6	122	74½	2.0
'39.....	74	115	47	83	137	93	88	102	94	17.1	112	66½	2.5
'40.....	112	141	58	111	167	149	117	140	128	17.1	—	72½	2.0
'41.....	140	142	65	125	181	162	131	154	142	18.0	—	79½	2.0
1942.....	170	148	66	140	184	163	142	160	151	18.1	—	82½	2.0
'43.....	156	166	72	138	187	166	156	167	155	18.1	—	80½	2.0
Average 1904-13	68	91	53	73	95	74	76	81	77	44.1	106	82½	3.733
1890-99	61	80	63	68	71	56	66	64	66	55.8	103	103½	2.958
'78-87	79	95	76	84	73	71	81	76	79	82.1	97	99½	3.264
1818-27	109	90	151	111	128	105	106	112	111	98.0	—	—	3.692

* Silver (see note on p. 268), parity of 1 gold to 15½ silver = 100.

† Wheat harvest in U.K. to 1895: 29 bushels = 100; from 1896: 30 bushels = 100.

‡ Average price of Consols and the average Bank of England rate of discount are actual figures, not index-numbers; Consols 3% to 1888, 2½% from 1889, 2½% from April, 1903.

THE STATIST'S Index Numbers—monthly averages by groups
(1867-77 = 100)

		Vegetable Food	Animal Food	Sugar, Tea, and Coffee	Food- stuffs	Min- erals	Tex- tiles	Sundry Mate- rials	Total Mate- rials	All Com- modities
1941										
Jan.	...	131.8	140.5	59.1	119.5	176.8	152.9	122.0	146.3	134.9
Feb.	...	130.4	140.5	62.0	119.7	179.2	152.5	125.9	148.4	136.3
March	...	127.7	142.8	64.6	120.0	181.0	159.0	126.2	151.1	138.0
April	...	135.4	142.8	65.0	123.3	180.9	159.7	132.8	154.1	141.1
May	...	138.4	142.8	65.6	124.7	181.5	161.5	138.7	157.2	143.5
June	...	140.0	142.8	65.3	125.3	181.1	163.7	140.2	158.4	144.4
July	...	143.3	142.8	64.4	126.5	182.3	164.5	140.2	159.0	145.3
Aug.	...	145.3	142.8	66.1	127.7	180.5	166.0	137.1	157.7	145.1
Sept.	...	146.5	142.8	65.7	128.1	180.3	166.2	138.2	158.2	145.5
Oct.	...	147.0	142.8	69.0	129.0	181.0	164.8	130.0	154.4	143.7
Nov.	...	150.9	142.8	69.0	130.7	181.6	162.9	135.2	156.2	145.5
Dec.	...	155.3	142.8	68.8	132.5	182.2	161.5	137.3	156.7	146.5
1942										
Jan.	...	163.3	142.8	68.9	135.9	181.5	161.5	140.7	158.0	148.6
Feb.	...	189.8	142.8	69.4	147.1	181.6	161.5	139.6	157.6	153.4
Mar.	...	185.8	147.3	69.5	147.1	181.8	160.4	141.5	158.1	153.5
April	...	187.6	147.3	69.4	147.9	182.4	160.4	144.1	159.4	154.5
May	...	190.0	147.3	69.7	149.0	183.1	160.4	150.3	162.2	156.6
June	...	188.3	147.3	69.6	148.2	181.1	160.4	144.0	159.0	154.4
July	...	159.0	147.3	70.2	136.0	184.7	159.0	144.8	160.0	150.0
Aug.	...	157.9	147.3	71.7	135.8	186.4	158.0	143.1	159.3	149.4
Sept.	...	158.3	147.3	72.2	136.1	186.4	158.0	144.3	159.9	149.7
Oct.	...	156.4	150.4	72.5	136.6	186.9	164.2	141.0	160.5	150.4
Nov.	...	156.6	151.5	70.5	136.6	187.0	164.7	144.1	162.0	151.3
Dec.	...	156.9	151.5	71.1	136.8	186.5	165.9	147.0	163.4	152.2
1943										
Jan.	...	158.5	155.7	73.3	139.5	187.8	165.5	147.1	163.8	153.3
Feb.	...	158.8	155.7	73.3	139.7	187.6	163.0	148.3	163.4	153.2
Mar.	...	160.0	155.7	71.9	139.9	188.5	163.3	149.8	164.3	154.0
April	...	160.3	155.7	72.9	140.2	187.9	164.3	152.4	165.6	154.9
May	...	159.9	155.7	73.0	140.1	188.7	165.3	154.5	167.0	155.6
June	...	159.4	155.7	73.5	140.0	188.4	165.6	153.5	166.6	155.4
July	...	163.3	155.7	73.8	141.7	187.6	163.9	154.9	166.5	156.0
Aug.	...	152.3	155.7	74.2	137.1	188.7	163.5	155.9	167.1	154.4
Sept.	...	152.7	155.7	74.3	137.3	188.2	162.8	157.1	167.2	154.6
Oct.	...	150.4	155.7	73.0	136.3	187.8	161.3	156.4	166.4	153.7
Nov.	...	149.6	155.7	74.7	136.1	187.5	160.6	158.2	166.8	153.9
Dec.	...	150.2	155.7	74.0	136.2	188.0	160.0	157.5	166.7	153.9
1944										
Jan.	...	151.2	155.7	74.1	136.6	190.1	160.8	159.4	168.1	154.9
Feb.	...	151.8	155.7	72.9	136.6	191.4	160.9	159.2	168.4	155.1
March	...	151.9	155.7	74.2	137.0	192.8	161.6	160.1	169.3	155.7
April	...	151.9	155.7	74.5	137.0	193.2	178.3	156.9	173.2	157.9
May	...	151.9	155.7	74.3	137.0	194.3	180.2	161.2	175.9	159.5
June	...	151.5	155.7	74.7	136.9	194.2	181.5	162.6	176.9	160.0
July	...	150.5	155.7	75.6	139.2	194.8	182.2	165.5	178.5	161.9
Aug.	...	149.9	155.7	77.4	136.8	197.8	184.1	164.5	179.5	161.5
Sept.	...	150.3	155.7	74.4	136.3	205.3	184.9	154.3	177.5	160.1
Oct.	...	150.3	155.7	73.7	136.2	203.9	184.1	154.3	176.8	159.6
Nov.	...	151.4	155.7	74.0	136.7	205.0	184.1	155.4	177.6	160.3

Quarterly Movements of Prices *

Summary of Index Numbers, 1867-77 = 100

Years	Quar- ters	Vegetable Food (Corn, etc.)	Animal Food (Meat etc.)	Sugar, Coffee, and Tea	Total Food	Min- erals	Tex- tiles	Sun- dry Mate- rials	Total Mate- rials	Grand Total	Sil- ver †
1932	I	80.7	109.2	52.2	83.2	101.1	67.5	87.8	85.2	85.2	21.0
	II	77.6	107.6	50.2	82.9	95.1	59.4	79.6	77.3	79.9	19.4
	III	68.2	105.3	49.6	77.9	100.6	65.9	80.7	81.5	80.0	19.4
	IV	64.2	98.2	48.4	73.4	101.2	64.5	80.2	81.0	77.8	18.4
'33	I	60.2	106.0	47.3	74.4	99.7	62.0	79.1	79.4	77.3	18.2
	II	59.1	108.4	47.4	74.8	109.7	68.7	79.8	84.2	80.2	20.0
	III	62.0	105.8	47.9	75.2	111.0	71.0	80.0	85.6	81.2	18.5
	IV	58.5	106.4	47.4	73.8	110.9	67.7	79.7	84.4	79.9	18.5
'34	I	59.4	110.1	53.0	76.7	111.7	73.6	79.9	80.5	82.4	19.1
	II	58.7	110.3	52.2	76.1	108.4	70.8	79.1	84.4	80.9	18.6
	III	71.0	109.5	48.0	80.4	108.5	70.7	78.7	84.3	82.6	19.7
	IV	66.7	107.3	44.8	77.0	109.7	70.9	79.6	85.0	81.6	22.1
'35	I	64.4	111.2	41.3	76.8	108.9	77.4	82.6	88.0	83.3	23.0
	II	67.1	107.9	42.3	76.9	112.3	79.4	82.8	89.8	84.3	29.3
	III	68.8	106.6	40.6	76.8	113.8	80.1	82.3	90.1	84.5	27.3
	IV	70.7	104.1	41.8	76.9	116.7	83.6	84.9	93.0	86.3	25.7
'36	I	72.1	104.6	41.2	77.6	116.1	84.6	86.4	93.8	87.0	18.2
	II	71.2	107.1	39.7	77.8	114.7	79.4	84.8	91.2	85.5	18.6
	III	75.3	112.6	39.1	81.5	116.7	80.5	90.0	94.2	89.8	18.6
	IV	85.8	110.7	42.6	85.9	129.6	88.2	93.8	101.7	95.0	18.9
'37	I	93.1	112.7	47.1	90.6	144.3	97.4	102.3	112.0	108.0	18.6
	II	94.3	121.0	49.6	94.7	143.5	99.9	102.9	112.8	105.2	18.7
	III	93.3	121.4	50.2	94.6	147.7	94.6	101.4	111.8	104.5	18.4
	IV	95.5	116.3	47.2	93.0	136.3	81.2	95.6	102.1	98.3	18.0
'38	I	92.3	116.4	43.1	90.8	134.8	77.8	92.4	99.3	95.7	18.5
	II	89.2	114.1	42.2	88.5	132.0	73.5	86.5	94.8	92.1	17.4
	III	78.0	107.4	42.9	81.4	135.9	73.9	85.0	95.3	89.4	17.3
	IV	68.8	105.8	43.3	77.1	140.6	74.3	85.1	96.7	88.4	17.4
'39	I	68.0	110.9	43.5	78.7	134.2	79.6	84.0	96.2	88.8	17.7
	II	66.7	112.9	46.9	79.6	134.4	85.7	85.3	98.7	90.6	17.3
	III	65.2	117.0	48.1	80.7	135.8	91.1	88.0	101.8	92.9	15.7
	IV	93.2	130.3	57.4	99.3	146.7	123.5	106.4	122.5	112.7	17.8
'40	I	104.2	141.2	57.4	108.0	160.1	141.2	116.1	135.6	124.0	16.3
	II	108.0	140.5	56.7	109.2	165.2	148.4	122.2	141.8	128.0	16.7
	III	117.3	140.5	58.6	113.5	171.1	148.6	122.2	143.4	130.9	17.6
	IV	127.5	140.5	58.8	117.8	173.5	151.9	119.8	144.1	133.0	17.9
'41	I	129.8	141.3	61.9	119.8	179.0	154.8	124.7	148.6	136.4	18.0
	II	137.9	142.8	65.3	124.4	181.2	161.6	137.2	156.6	143.0	18.0
	III	145.0	142.8	65.4	127.4	181.0	165.6	138.5	158.3	145.3	18.0
	IV	151.0	142.8	68.9	130.7	181.6	163.1	134.2	155.8	145.2	18.1
'42	I	179.6	144.3	69.3	143.4	181.6	161.1	140.6	157.9	151.8	18.1
	II	188.6	147.3	69.5	148.3	182.2	160.4	146.1	160.2	155.2	18.1
	III	158.4	147.3	71.4	136.0	185.8	158.3	144.1	159.7	149.7	18.1
	IV	156.6	151.1	71.4	136.7	186.8	164.9	145.0	162.0	151.3	18.1
'43	I	159.1	155.7	72.8	139.7	188.0	163.9	148.4	163.8	153.5	18.1
	II	159.9	155.7	73.1	140.1	188.3	165.1	153.5	166.4	155.3	18.1
	III	156.1	155.7	74.1	138.7	188.2	163.4	156.0	166.9	155.0	18.1
	IV	150.1	155.7	74.2	136.2	187.8	160.8	157.4	166.6	153.8	18.1

* The averages of the four quarterly figures to each year do not necessarily coincide with the annual averages, as the latter are based as far as possible on average weekly prices. See also the *Journal*, 1893, p. 221; 1895, p. 144; 1901, p. 90; and 1909, p. 70.

† Silver, parity of 1 gold to 15½ silver = 100.

Construction of the Tabular Statements

The following table illustrates the method of construction of the index numbers. The index numbers here given are based on the average prices for the eleven years 1867-77. Take, for instance, the *Gazette* price of English wheat:—

		s.	d.	
Average, 1867-77	...	54	6	= 100, average point.
" 1914	...	35	0	= 64, or 36 per cent. <i>below</i> the average point.
" 1930	...	80	7	= 148, " 48 " <i>above</i> " "
" 1936	...	53	3	= 98, " 2 " <i>below</i> " "

The individual index numbers, therefore, represent simple percentages of the average point.

The articles are grouped in six categories:—

	Index Nos.	1867-77 Total Numbers	Example for 1943	
			Total Numbers	Average
1. Vegetable food, corn, etc. (wheat flour, barley, oats, maize, potatoes, and rice) ...	8	800	1,247	156
2. Animal food (beef, mutton, pork, bacon, and butter) ...	7	700	1,090	156
3. Sugar, coffee, and tea ...	4	400	287	72
1-3. <i>Food</i> ...	19	1,900	2,624	138
4. Minerals (iron, copper, tin, lead, and coal) ...	7	700	1,312	187
5. Textiles (cotton, flax, hemp, jute, wool, and silk) ...	8	800	1,327	166
6. Sundry materials (hides, leather, tallow, oils, soda, nitrate, indigo, and timber) ...	11	1,100	1,715	156
4-6. <i>Materials</i> ...	26	2,600	4,354	167
<i>General Average</i> ...	45	4,500	6,978	155

The general average is drawn from all forty-five descriptions, which are treated as of equal value, and is the simple arithmetic mean as shown above.

Index of Silver Prices

The base of the index numbers given below is 60·84d. per standard oz. = 100, this being a parity of 1 fine oz. of gold to 15½ standard ozs. of silver.*

	Price per oz. standard	Index number		Price per oz. standard	Index number
	d.			d.	
Average 1873 ...	59½	=97·4	Lowest Nov., 1902	21½	=35·6
" '90-99...	34	=55·8	End Dec., 1906	32½	=53·1
" 1917-26...	40½	=66·6	" Dec., '08	23½	=38·1
" 1893 ...	35½	=58·6	" Dec., '12	29	=47·7
" '96 ...	30½	=50·5	" Dec., '13	26½	=43·7
" 1914 ...	25½	=41·6	" Dec., '14	22½	=37·3
" '15 ...	23½	=38·9	" Dec., '15	26½	=43·1
" '16 ...	31½	=50·4	" Dec., '16	30½	=58·7
" '17 ...	40½	=65·8	" Dec., '17	43½	=70·0
" '18 ...	47½	=76·4	" Dec., '18	48½	=77·0
" '19 ...	57	=85·3	" Dec., '19	77½	=98·3
" '20 ...	61½	=76·1	" Dec., '20	40½	=49·2
" '21 ...	36½	=48·1	" Dec., '21	34½	=49·3
" '22 ...	34½	=51·6	" Dec., '22	31½	=49·6
" '23 ...	31½	=49·4	" Dec., '23	33½	=49·0
" '24 ...	34	=50·7	" Dec., '24	31½	=50·4
" '25 ...	32½	=52·5	" Dec., '25	31½	=52·1
" '26 ...	28½	=47·1	" Dec., '26	25	=41·1
" '27 ...	26½	=42·8	" Dec., '27	26½	=43·6
" '28 ...	26½	=44·0	" Dec., '28	26½	=43·3
" '29 ...	24½	=40·2	" Dec., '29	21½	=35·2
" '30 ...	17½	=29·0	" Dec., '30	14½	=23·7
" '31 ...	14½	=20·4	" Dec., '31	20½	=21·6
" '32 ...	17½	=19·5	" Dec., '32	16½	=17·2
" '33 ...	18½	=18·7	" Dec., '33	19½	=19·5
" '34 ...	21½	=20·0	" Dec., '34	24½	=22·6
" '35 ...	29	=26·4	" Dec., '35	22½	=20·6
" '36 ...	20½	=18·5	" Dec., '36	21½	=19·4
" '37 ...	20½	=18·4	" Dec., '37	19½	=17·7
" '38 ...	19½	=17·6	" Dec., '38	20½	=17·3
" '39 ...	20½	=17·1	" Dec., '39	22½	=17·3
" '40 ...	22½	=17·1	" Dec., '40	23½	=17·9
" '41 ...	23½	=18·0	" Dec., '41	23½	=18·1
" '42 ...	23½	=18·1	" Dec., '42	23½	=18·1
" '43 ...	23½	=18·1	" Dec., '43	23½	=18·1

* All the index numbers in the table from 1916 to 1925 inclusive and from 1931 to date are calculated on the basis of the gold prices of silver instead of the sterling prices, though the latter are the price quotations given in the table. In arriving at the index numbers for these dates the prices of gold are taken as follows. For 1916, 1917 and 1918 the price is taken as 86s. 9½d. per fine oz., derived from the "pegged" New York rate of \$4·76½ to the £. For 1919 the average price of gold is taken as 93s. 4½d., this being the parity price with the U.S. dollar, the average New York exchange in that year being \$4·429. For the other dates the index numbers are based on the quotations in the London market for exportable gold. The quotation at the end of 1919 was 109s. 8½d. per fine oz. At the end of 1920, 1921, 1922, 1923 and 1924 the quotations per fine oz. were 116s. 1d., 98s. 0d., 88s. 11d., 95s. 4d., and 88s. 2d. respectively and the average quotations in these years were 112s. 11½d., 107s. 0½d., 93s. 4d., 90s. 3d., and 93s. 8½d. respectively, while the average price in 1925 was 85s. 5½d. The prices at the end of 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942 and 1943 were 121s. 11d., 123s. 9d., 126s. 6d., 141s. 0d., 141s. 2d., 141s. 7d., 139s. 6d., 149s. 7½d., 168s., 168s., 168s., 168s. and 168s. respectively, and the average prices in these years were 92s. 6½d., 118s. 0½d., 124s. 10½d., 137s. 7½d., 124s. 1½d., 140s. 3½d., 140s. 8½d., 142s. 6½d., 154s. 4d., 168s., 168s., 168s. and 168s. respectively.

World's Production of Silver (in millions of ounces)

	United States	Mexico	Canada	Australia	Other Countries	Total
1904...	57.7	60.8	3.7	14.5	27.5	164.2
'05...	56.1	65.0	5.9	15.0	30.3	172.3
'06...	56.5	55.2	8.5	14.2	30.6	165.0
'07...	56.5	61.0	12.8	19.0	34.8	184.2
'08...	52.4	73.6	22.1	17.2	37.8	203.1
'09...	54.7	73.9	27.5	16.3	39.7	212.1
'10...	57.1	71.4	32.9	21.5	38.8	221.7
'11...	60.4	79.0	32.7	16.6	37.5	226.2
'12...	63.8	74.6	31.6	18.1	36.2	224.3
'13...	66.8	70.7	31.5	3.5	51.4	223.9
'14...	72.4	27.5	28.4	3.6	36.5	168.4
'15...	74.9	39.5	28.4	4.1	37.3	184.2
'16...	74.4	38.2	25.4	4.2	26.6	168.8
'17...	71.7	35.0	22.2	10.0	35.3	174.2
'18...	67.8	62.5	21.2	10.0	35.9	197.4
'19...	56.7	62.7	15.7	7.4	32.0	174.5
'20...	55.5	66.8	12.6	7.5	33.0	175.4
'21...	53.1	64.5	13.1	4.9	35.7	171.3
'22...	56.2	81.1	18.6	11.3	46.3	213.5
'23...	73.3	90.9	17.8	13.3	50.7	246.0
'24...	65.3	91.5	19.7	10.8	52.2	239.5
'25...	66.1	92.9	20.2	11.1	54.8	245.1
'26...	62.7	98.3	22.4	11.2	59.0	253.6
'27...	60.4	104.6	22.7	9.0	57.3	254.0
'28...	58.4	108.5	21.9	9.0	59.5	257.3
'29...	61.2	108.7	23.1	9.0	59.7	261.7
'30...	51.0	105.0	26.0	8.9	57.1	248.0
'31...	31.0	86.0	21.0	7.6	50.4	196.0
'32...	24.0	69.0	18.0	6.5	47.5	165.0
'33...	22.8	68.1	15.2	11.0	52.0	169.1
'34...	32.5	74.1	16.4	10.8	56.6	190.4
'35...	45.6	75.6	16.6	11.4	71.5	220.7
'36...	63.4	77.5	18.3	12.7	81.8	253.7
'37...	71.3	84.7	22.7	14.3	80.9	273.9
'38...	61.7	81.0	23.8	101.3		267.8
'39...	63.9	75.9	24.5	101.6		265.9
'40...	68.3	82.6	25.3	96.3		272.5
'41...	71.1	78.4	23.4	80.9		262.8
'42*	54.0	80.0	22.3	—		—
'43*	44.5	87.0	18.5	—		—

* Provisional. (Estimate by Messrs. Samuel Montagu & Co.)

(000's omitted)

Year	Value of output £	Year	Value of output £
1851	17,200	1898	58,949
'52	26,550	'99	63,027
'53	31,090	1900	52,312
'54	25,490	'01	53,630
'55	27,015	'02	60,975
'56	29,520	'03	67,337
'57	26,655	'04	71,380
'58	24,930	'05	78,143
'59	24,970	'06	82,707
'60	23,850	'07	84,857
'61	22,760	'08	90,995
'62	21,550	'09	93,302
'63	21,390	'10	93,544
'64	22,600	'11	94,930
'65	24,040	'12	95,783
'66	24,220	'13	97,481
'67	22,805	'14	92,709
'68	21,945	'15	97,114
'69	21,245	'16	92,597
'70	21,370	'17	87,236
'71	25,400	'18	78,605
'72	24,200	'19	73,078
'73	23,600	'20	68,522
'74	22,950	'21	67,848
'75	22,700	'22	66,723
'76	22,540	'23	77,888
'77	23,830	'24	81,807
'78	22,020	'25	82,267
'79	21,400	'26	82,211
'80	22,130	'27	82,582
'81	21,150	'28	82,400
'82	20,500	'29	84,500
'83	20,640	'30	88,500
'84	20,830	'31	95,100
'85	21,250	'32	103,400
'86	21,430	'33	107,700
'87	21,735	'34	116,000
'88	22,644	'35	125,700
'89	25,375	'36	140,900
'90	24,421	'37	148,700
'91	26,846	'38	150,000
'92	30,134	'39	165,900
'93	32,363	'40	173,400
'94	37,229	'41	170,400
'95	40,843	'42 (provisional) ...	152,200
'96	41,559	'43 (provisional) ...	125,800
'97	48,509		

Gold.—The table shows the world's annual gold production since 1851. Prior to 1911 the estimates are those of the Bureau of the U.S. Mint and other authorities. The estimates since 1926 are those of the Union Corporation, Limited. The value is taken throughout at £4.25 per fine oz.

Average Prices of Commodities *

No. of Article	0	1	2	3	4	5	6	7	8	1-8	9	10
		Wheat		Flour	Barley	Oats	Maize §	Pota- toes *	Rice	Veg- etable Food	Beef ‡	
Year	Silver †	English Gazette	Ameri- can	Town Made white(now "G.R.") s. per sack (280 lbs.)	English Gazette	English Gazette	Ameri- can Mixed	Good English	Rangoon Carries to Arrive	Total	Prime	Mid- dling
	d. per oz.	s. and d. per qr.	s. and d. per qr.		s. and d. per qr.	s. and d. per qr.	s. per qr.	s. per ton	s. and d. per cwt.		d. per 8 lbs.	d. per 8 lbs.
1922 ...	34 7 ¹ / ₈	47-10	52-11	45 1 ¹ / ₂	40-1	29-1	31 1 ¹ / ₂	130	14-10	—	88 1 ¹ / ₂	82
'23 ...	31 1 ¹ / ₈	42-2	47 3	39 1 ¹ / ₂	33-8	26-8	36	101	14-10	—	79 1 ¹ / ₂	74 1 ¹ / ₂
'24 ...	34	49-3	53-9	43 1 ¹ / ₂	46-9	27-2	39 3 ¹ / ₈	186	16-9	—	82 1 ¹ / ₂	76 1 ¹ / ₂
'25 ...	32 1 ¹ / ₈	52-2	62-4	50 1 ¹ / ₂	42-0	27-2	38 1 ¹ / ₈	154	16-0	—	80	73 1 ¹ / ₂
'26 ...	28 1 ¹ / ₈	53-3	58-9	49 1 ¹ / ₂	36-11	25-1	29 1 ¹ / ₈	127	16-3	—	74	67
'27 ...	26 1 ¹ / ₈	49-3	58-3	44 1 ¹ / ₂	42-0	25-4	30 1 ¹ / ₈	136	15-11	—	70	62
'28 ...	26 1 ¹ / ₈	44-8	50-10	40 1 ¹ / ₂	39-0	29-0	38 1 ¹ / ₈	133	15-0	—	74	66 1 ¹ / ₂
'29 ...	24 1 ¹ / ₈	42-2	51-3	38 1 ¹ / ₂	35-5	24-7	36 1 ¹ / ₂	111	14-3	—	71	66
'30 ...	17 1 ¹ / ₈	34-3	36-10	33 1 ¹ / ₂	28-3	17-2	23	93	13-0	—	73	68
'31 ...	14 1 ¹ / ₈	24-0	25-1	22 1 ¹ / ₂	28-0	17-8	15 1 ¹ / ₈	146	9-8	—	67	61
'32 ...	17 1 ¹ / ₈	25-0	27-5	24 1 ¹ / ₂	27-1	19-3	18 1 ¹ / ₈	152	9-8	—	65	59
'33 ...	18 1 ¹ / ₈	22-10	25-7	23 1 ¹ / ₂	28-7	15-10	17 1 ¹ / ₈	86	7-9	—	61	52
'34 ...	21 1 ¹ / ₈	20-2	28-0	23 1 ¹ / ₂	30-11	17-5	19 1 ¹ / ₈	97	7-8	—	58	52
'35 ...	29	22-2	31-1	25 1 ¹ / ₂	28-7	18-9	17 1 ¹ / ₂	107	8-10	—	54	49
'36 ...	20 1 ¹ / ₈	30-9	35-1	31 1 ¹ / ₂	29-5	17-8	19 1 ¹ / ₈	146	9-0	—	54	50
'37 ...	20 1 ¹ / ₈	40-0	49-7	40 1 ¹ / ₂	39-0	23-11	26 1 ¹ / ₈	136	10-5	—	61	57
'38 ...	19 1 ¹ / ₈	28-11	39-3	30 1 ¹ / ₂	36-4	21-2	28 1 ¹ / ₈	111	10-7	—	62	58
'39 ...	20 1 ¹ / ₈	21-5	30-1	22 1 ¹ / ₂	31-7	19-3	26 1 ¹ / ₈	117	11-1	—	61	58
'40 ...	22 1 ¹ / ₈	42-10	33-6	24 1 ¹ / ₂	64-10	37-2	39 1 ¹ / ₈	143	15-5	—	72	68
'41 ...	23 1 ¹ / ₈	62-10	32-2	27 1 ¹ / ₂	85-8	40-10	43	164	23-8	—	72	68
'42 ...	23 1 ¹ / ₈	68-6	36-9	35	165-5	42-0	43	134	26-0	—	76	68
'43 ...	23 1 ¹ / ₈	69-8	45-5	38 1 ¹ / ₂	112-5	43-8	43	111	27-2	—	79	71
Average												
1904-13	26 1 ¹ / ₈	31 1 ¹ / ₈	36	30	25 1 ¹ / ₈	18 1 ¹ / ₈	24 1 ¹ / ₈	78	7 1 ¹ / ₂	—	51	44 1 ¹ / ₂
1890-99	34	28 1 ¹ / ₈	31 1 ¹ / ₈	27 1 ¹ / ₈	25 1 ¹ / ₈	17 1 ¹ / ₈	19 1 ¹ / ₈	72	6 1 ¹ / ₂	—	47	37 1 ¹ / ₂
'78-87	50	40	43 1 ¹ / ₂	34 1 ¹ / ₂	31 1 ¹ / ₂	21	25	102	8	—	55 1 ¹ / ₂	46
'67-77	58 1 ¹ / ₂	54 1 ¹ / ₂	56	46	39	26	32 1 ¹ / ₂	117	10	—	59	50

Index Numbers (or Percentages) of Prices, the Average of 1887-77 being 100

1922 ...	51-6	88	95	100	103	112	96	111	148	853	150	164
'23 ...	49-4	77	84	86	86	103	111	86	148	781	134	149
'24 ...	50-7	90	96	95	120	105	122	169	167	954	139	152
'25 ...	52-5	96	111	109	108	105	119	132	160	940	136	147
'26 ...	47-1	98	105	107	95	96	92	109	163	865	125	134
'27 ...	42-8	90	104	98	108	97	95	116	159	807	119	124
'28 ...	44-0	82	91	87	100	112	118	114	150	854	125	133
'29 ...	40-2	77	91	84	91	95	112	95	143	788	120	132
'30 ...	20-0	63	66	72	72	60	71	79	130	619	124	136
'31 ...	20-4	44	45	50	71	68	48	125	93	544	114	122
'32 ...	19-5	46	49	53	69	74	58	130	93	572	110	118
'33 ...	18-7	42	46	52	73	61	53	74	78	479	103	104
'34 ...	20-0	37	50	50	79	67	60	83	77	503	98	104
'35 ...	26-4	41	56	56	73	72	53	91	88	530	92	98
'36 ...	18-5	56	63	69	75	68	60	125	90	606	92	100
'37 ...	18-4	73	89	88	100	92	82	116	105	745	103	114
'38 ...	17-6	53	70	67	93	81	86	95	106	661	105	116
'39 ...	17-1	39	54	48	81	74	82	100	111	589	103	116
'40 ...	17-1	78	60	53	166	143	122	122	154	898	122	136
'41 ...	18-0	115	57	60	220	157	132	140	236	1,117	122	136
'42 ...	18-1	126	66	76	424	162	132	115	260	1,361	129	136
'43 ...	18-1	128	81	83	288	168	132	95	272	1,247	134	142

* The annual prices are the average monthly or weekly quotations, except potatoes, which are the average weekly quotations during the eight months January to April and September to December.

† Not included in the general average.

‡ Meat (9-13), by the carcass, in the London Central Meat Market.

§ La Plata from 1924.

Average Prices of Commodities—Contd.

No. of Article }	11		13	18	14	15	9-15	16A	16B	17	18A ^u	18B ^u	18
	Mutton			Pork	Bacon	Butter	Animal Food Total	Sugar			Coffee		
	Prime	Mid-ling		Large and Small, average	Water-ford	Friesland, Fine to Finest		British West Indian Refining ||	Beet, (German, 84 p. c.) L.O.B.	Java, Floating Cargoes	Ceylon Plantation, Low Mid-ling	Rio, Good	Mean of 18A and 18B
Year	d. per 8 lbs.	d. per 8 lbs.		d. per 8 lbs.	s. per cwt.	s. per cwt.		s. per cwt.	s. per cwt.	s. per cwt.	s. per cwt.	s. per cwt.	
1922 ...	125	121½		101	145½	202½	—	15	14½	15 ½	120½	74½	—
'23 ...	114½	107½		89	113½	186	—	25½	23½	24½	117½	55	—
'24 ...	111½	103½		70	106	211	—	23½	20½	21½	152½	85½	—
'25 ...	106½	98½		84½	128½	206½	—	16½	11½	12½	153½	98½	—
'26 ...	89	80½		98½	130	173	—	16 ⅞	11½	12½	154½	89 ⅞	—
'27 ...	86	79½		85	102½	178	—	16 ⅞	12½	13 ⅞	143½	71½	—
'28 ...	92½	87		77	101½	185½	—	13½	10½	11½	143½	81½	—
'29 ...	89½	83		91	116½	180½	—	11 ⅞	8 ⅞	8 ⅞	141½	74½	—
'30 ...	92	86		89	105½	146½	—	8½	5½	6½	106½	42½	—
'31 ...	79	73		65	83½	130	—	7½	5½	6 ⅞	101½	33½	—
'32 ...	63	55		54	77	126½	—	7½	5½	5½	105½	54½	—
'33 ...	69	63		60	81½	105 ⅞	—	7 ⅞	4½	5½	80½	42½	—
'34 ...	74	70		65	90 ⅞	79½	—	6 ⅞	4½	4½	87½	42½	—
'35 ...	75	70		62	89	92½	—	6 ⅞	4½	4½	87½	29½	—
'36 ...	73	68		65	93½	98½	—	6½	3½	4½	58½	30½	—
'37 ...	78	74		68	94	108½	—	7½	5½	6½	75½	36½	—
'38 ...	62	56		69	97½	114½	—	7½	4½	5½	75	19½	—
'39 ...	68	64		70	97½	122	—	9 ⅞	6 ⅞	7 ⅞	73½	22½	—
'40 ...	85	76		96	114½	143	—	9½	—	8½	86½	28½	—
'41 ...	85	76		96	123½	142½	—	9½	—	8½	137½	30½	—
'42 ...	90	78		101	130	143½	—	9½	—	8½	130½	28½	—
'43 ...	96	84		102	142	151½	—	9½	—	8½	140½	37½	—
Average 1904-13	58½	51½		47½	67	113	—	10½	10½	12	75½	43½	—
1890-99	54½	41½		42½	59	100	—	11½	11½	13½	98	62	—
'78-87	64½	53		49	71	116	—	17	18	21½	78	52	—
'67-77	63	55		52	74	125	—	23	24	28½	87	64	—

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

	199	221	194	196	162	1,286	62	54	140	116	128
1922 ...	199	221	194	196	162	1,286	62	54	140	116	128
'23 ...	182	196	171	154	149	1,135	104	87	135	86	111
'24 ...	177	188	135	143	169	1,103	93	75	175	133	154
'25 ...	169	180	162	174	165	1,133	60	43	176	154	165
'26 ...	141	146	190	176	138	1,050	60	44	178	139	159
'27 ...	136	145	163	138	142	967	62	47	165	112	139
'28 ...	146	158	148	137	149	998	51	40	165	127	146
'29 ...	142	151	175	157	144	1,021	42	31	162	117	140
'30 ...	146	155	171	143	117	992	31	22	123	66	95
'31 ...	125	133	125	113	104	836	29	23	120	53	87
'32 ...	100	100	104	104	101	737	27	20	121	85	103
'33 ...	110	114	115	110	84	740	25	18	100	66	83
'34 ...	117	127	125	122	64	757	22	16	100	67	84
'35 ...	119	127	119	120	74	749	21	17	78	46	62
'36 ...	116	124	131	127	79	763	21	17	67	48	58
'37 ...	124	135	125	127	86	820	28	23	87	57	72
'38 ...	98	102	133	131	92	777	24	19	86	31	59
'39 ...	108	116	135	132	98	808	32	26	85	35	60
'40 ...	135	138	185	155	114	985	42	29	99	44	72
'41 ...	135	138	185	167	114	997	42	29	158	47	102
'42 ...	143	142	194	176	115	1,035	42	29	150	45	98
'43 ...	152	153	196	192	121	1,090	42	29	161	58	109

* Index numbers not included in general average.

† Nominal.

‡ E. India good middling from 1908. § Raw Centrifugals, 98% Pol., from 1924. || White Javas, C.I.F., from 1924.

Average Prices of Commodities—Contd.

No. of Article } Year	19A*	19n* Tea	19	16-10 Sugar, Coffee, and Tea Total	1-19 Food Total	20A Scottish Pig s. and d. per ton	20B Cleveland (Mid- dles- brough) Pig s. and d. per ton	21 Bars, Com- mon per ton	22 Copper Stand- ard £ per ton	23 Tin Strait £ per ton	24 Lead English Pig £ per ton	25 Coal Wallend Hutton in London § £ per ton
	Ongou, Com- mon d. per lb.	Average Import Price d. per lb.	Mean of 19A and 19B									
1922 ...	8½	14-9	—	—	—	99-10	90-7	11½	63½	162	25½	34½
'23 ...	11	17-58	—	—	—	108-0	108-9	11½	65½	206	28½	32½
'24 ...	9½	19-0	—	—	—	96-8	88-2	12½	63½	261	35½	27½
'25 ...	7½	18-34	—	—	—	83-4	72-8	11½	61½	267	37½	29½
'26 ...	7½	18-82	—	—	—	87-2	87-6	11½	58½	297½	32½	**30½
'27 ...	6½	18-58	—	—	—	80-5	73-0	11½	55½	303½	25½	23½
'28 ...	6½	16-84	—	—	—	69-9	65-9	9½	63½	229½	22½	21½
'29 ...	6½	16-11	—	—	—	74-0	70-3	9½	75½	207½	24½	23½
'30 ...	5½	15-12	—	—	—	76-0	67-0	9½	54½	144½	19½	24½
'31 ...	4½	13-29	—	—	—	71-0	58-6	10½	38½	121½	14½	24½
'32 ...	4½	10-75	—	—	—	68-2	58-6	10	31½	140	13½	23½
'33 ...	6½	11-87	—	—	—	66	62-3	9½	32½	202½	13½	22½
'34 ...	8½	13-20	—	—	—	69-6	66-11	9½	30½	232½	12½	20½
'35 ...	6½	13-06	—	—	—	70-6	67-10	9½	32½	230½	16	20½
'36 ...	6½	13-19	—	—	—	78-6	73-2	10½	37½	207½	19½	23½
'37 ...	6½	14-58	—	—	—	104-6	94-4	12½	54½	246½	24½	24½
'38 ...	6½	14-04	—	—	—	118-0	109	13½	41½	193½	17½	25½
'39 ...	6½	14-18	—	—	—	104-3	100-7	12½	44½	232½	17½	25½
'40 ...	—	15-33	—	—	—	114-10	116-4	14½	62	273½	26½	28½
'41 ...	—	15-13	—	—	—	123	128	15½	62	284½	26½	30½
'42 ...	—	16-25	—	—	—	123	128	15½	62	275	26½	32½
'43 ...	—	18-44	—	—	—	123	128	15½	62	275	—	34½
Average	7½	8½	—	—	—	57½	51½	6½	67½	164½	15½	18½
1904-13	4½	9½	—	—	—	47	41½	5½	50	81	12	17½
1890-99	6½	12½	—	—	—	46	38	5½	55	89	14	16½
'78-87	6½	12½	—	—	—	69	60	8½	75	105	20½	22
'87-77	11½	17½	—	—	—	—	—	—	—	—	—	—

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

	*77	*86	82	326	2,465	148	136	84	154	123	156
1922 ...	77	86	82	326	2,465	148	136	84	154	123	156
'23 ...	98	102	100	402	2,318	168	144	88	196	139	147
'24 ...	82	110	96	418	2,475	143	152	84	239	175	125
'25 ...	70	106	88	356	2,429	121	144	82	254	183	135
'26 ...	69	109	89	352	2,267	135	139	77	283	157	138
'27 ...	60	108	84	332	2,166	119	136	74	289	125	105
'28 ...	56	98	77	314	2,164	105	120	55	219	109	97
'29 ...	54	93	74	287	2,090	112	118	101	198	117	106
'30 ...	46	88	67	215	1,826	111	121	73	138	95	113
'31 ...	42	78	60	199	1,679	100	123	52	115	71	112
'32 ...	38	62	50	200	1,609	98	121	43	131	65	106
'33 ...	58	68	63	189	1,408	99	117	44	193	65	103
'34 ...	77	77	77	199	1,459	106	116	40	221	61	92
'35 ...	60	76	68	168	1,447	107	117	43	219	78	92
'36 ...	56	76	66	162	1,531	118	123	50	198	95	105
'37 ...	58	85	72	195	1,760	154	149	73	235	121	111
'38 ...	58	81	70	172	1,600	176	161	56	185	83	117
'39 ...	56	82	69	187	1,584	159	150	59	221	85	115
'40 ...	—	89	89	232	2,115	179	173	83	260	129	127
'41 ...	—	88	88	261	2,375	195	189	83	271	129	141
'42 ...	—	94	94	263	2,659	195	189	83	262	129	148
'43 ...	—	107	107	287	2,624	195	189	83	262	129	150

* Index numbers not included in the general average.

† Nominal.

§ Best Yorkshire house after 1910.

** Average price January-April, 1936.

|| First 9 months only.

Average Prices of Commodities—Contd.

No. of Article }	26	20-26	27	28	29A	29B	30A	30B	31	32A	32B	33
	Coal	Minerals	Cotton		Flax		Hemp		Jute	Wool		
Year	Average Export Price £ per ton	Total	Middle-American d. per lb.	Fair Dholera II d. per lb.	Petrograd † £ per ton	Russian Average Import Price £ per ton	Manila Fair Roping £ per ton	Petrograd Clean (6) £ per ton	Good Medium †† £ per ton	Merino, Port Phillip, Average Fleece d. per lb.	Merino, Adelaide Average Greasy d. per lb.	English, Lincoln Half Hogs d. per lb.
1922 ...	24-16	—	12-10	8	95	84½	33½	57½	30½	39	17½	9½
'23 ...	25-13	—	15-25	10	83½	84½	33½	57	26	43½	20½	12
'24 ...	23-38	—	16-28	11-03	120	104½	44	81	31½	53½	25½	18½
'25 ...	20-08	—	12-64	11-01	92½	120½	46½	89½	49½	41½	17½	17½
'26 ...	18-59	—	9-40	7-75	65	72½	43	74½	43½	36½	16½	15
'27 ...	17-80	—	9-54	8-27	95½	74½	43½	66½	32½	38½	17½	15½
'28 ...	15-67	—	10-92	8-66	98½	91½	37½	63½	33½	37	17½	17½
'29 ...	16-13	—	10-26	7-73	76½	71½	37½	61	32	35½	13½	16½
'30 ...	16-64	—	7-49	5-12	53½	60½	26½	48½	20	18½	8½	10½
'31 ...	15-98	—	5-90	4-60	36	35½	18½	27½	15½	14-7	7-1	8½
'32 ...	16-27	—	5-24	4-85	45½	42½	18½	36	16½	15-0	7-2	5½
'33 ...	16-08	—	5-54	4-53	51½	48½	15½	37	14½	10-9	9-3	5½
'34 ...	16-08	—	6-70	4-80	60½	50½	14½	42½	14½	21½	10-4	7
'35 ...	16-30	—	6-71	5-42	79½	72½	19½	43½	16½	20-1	9-5	7½
'36 ...	16-98	—	6-71	5-12	63½	60½	28½	42½	17½	24-7	12-2	10½
'37 ...	19-05	—	6-21	4-80	78½	70½	34½	38½	19½	26-9	12-7	16-9
'38 ...	21-32	—	4-93	3-67	66½	63½	21½	38½	17½	18-6	8-9	11-9
'39 ...	21-12	—	5-95	4-41	90½	72½	22½	48½	26½	17-9	9-0	12-2
'40 ...	27-23	—	8-10	6-26	177½	183½	26½	100½	27½	20-6	14-9	10-4
'41 ...	32-22	—	9-14	7-65	200½	—	31½	126½	26½	32	16½	21
'42 ...	34-87	—	8-83	7-37	200½	201-6	33½	130½	24½	32	16½	21
'43 ...	38-91	—	7-83	6-38	200½	205½	33½	130½	33½	32	16½	21
Average	11½	—	6½	5	32½	36½	30½	31½	18½	17½	9	10½
1904-13	10½	—	4½	3	27	27	26½	25	12½	13½	6½	10
1890-99	9	—	6	4½	33	34	35½	26½	15	18½	8½	11½
'78-87	12½	—	9	6½	46	48	43	35	19	21½	9½	19½

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1922 ...	193	994	134	118	191	116	162	180	49
'23 ...	201	1,083	169	148	179	116	137	206	61
'24 ...	187	1,105	181	163	239	160	167	254	96
'25 ...	161	1,080	140	163	227	174	261	188	87
'26 ...	149	1,078	104	115	147	151	231	170	76
'27 ...	142	990	106	123	181	141	172	177	78
'28 ...	125	860	121	128	203	130	178	174	91
'29 ...	129	831	114	114	157	126	168	156	81
'30 ...	133	784	83	76	121	96	105	86	54
'31 ...	127	700	66	68	76	58	84	70	43
'32 ...	130	694	58	72	93	70	85	71	29
'33 ...	129	750	62	67	106	68	78	94	30
'34 ...	129	765	74	71	119	73	74	102	35
'35 ...	130	786	74	80	161	80	89	96	37
'36 ...	136	825	74	76	133	91	93	119	53
'37 ...	152	995	69	71	158	93	104	127	86
'38 ...	171	949	55	54	139	77	93	88	60
'39 ...	169	953	66	65	174	91	140	86	62
'40 ...	218	1,169	90	93	383	163	146	142	98
'41 ...	258	1,266	101	113	416	202	139	155	106
'42 ...	279	1,285	98	109	427	209	130	155	106
'43 ...	295	1,312	87	95	431	209	174	155	106

* Port Philip fleece washed nominal since 1895, exactly in proportion with the value of clean wool.

† Approximate.

‡ Nominal.

|| Now No. 1 Comra, Fino.

¶ Livonian Z.E. from 1921.

†† Lightnings from 1921.

Dalses ‡ in 1943.

(a) Russian Sirotz Group 1, Sort 1 from 1921-33; Jug-Slav Peasant from 1934.

Average Prices of Commodities—Contd.

No. of Article }	34	27-34	35A		35B	35C	36A	36B	37	38	39	40A	40B
	Silk		Hides				Leather		Tallow		Oil		Seeds
	Year	Tanbles †	Textiles Total	River Plate, Dry	River Plate, Salted	Average Import Price	Dressing Hides	Average Import Price	Town	Palm	Olive	Lin- seed	Lin- seed
	s. per lb.			d. per lb.	d. per lb.	d. per lb.	d. per lb.	d. per lb.	s. per cwt.	£ per ton	£ per ton	£ per ton	s. per qr.
1922 ...	28½	—	—	9½	8½	8-06	24½	36	34½	34½	75½	39½	75½
'23 ...	24½	—	—	9½	8½	8-23	23½	31½	36½	36½	66½	42½	77½
'24 ...	23½	—	—	10½	8½	8-63	22½	33½	42½	40½	79½	42½	81½
'25 ...	18½	—	—	11½	8½	9-87	23	33	42½	40½	73½	43½	80½
'26 ...	15½	—	—	10½	8	9-32	21½	35½	38½	37½	79½	32½	63½
'27 ...	15½	—	—	12½	10½	9-85	22½	36½	33½	34½	102½	31½	64½
'28 ...	14	—	—	15½	11½	12-09	23½	37½	36½	35½	80½	29½	66½
'29 ...	13½	—	—	10½	8½	10-80	19½	38½	36½	34½	72	35½	74½
'30 ...	10½	—	—	6½	6½	7-80	18½	33½	28½	25½	52½	36½	61½
'31 ...	8½	—	—	5½	5½	6-12	17½	32½	19½	19½	53½	18½	38½
'32 ...	8½	—	—	4½	4½	5-47	17½	28½	21½	17½	57½	17	38½
'33 ...	6½	—	—	5½	4½	5-65	17½	26½	19½	15½	53½	20½	39½
'34 ...	5½	—	—	4½	4½	5-71	17½	25½	17½	13½	62½	21½	42½
'35 ...	5½	—	—	5½	5½	5-51	17½	25½	24½	19½	61½	24½	43½
'36 ...	5½	—	—	6½	6	6-47	17½	27½	23½	19½	70½	28½	48½
'37 ...	8½	—	—	8½	7½	8-62	18½	28½	23½	22½	95½	31½	54½
'38 ...	7½	—	—	6½	5½	6-35	14½	24½	17½	14½	68½	26½	46½
'39 ...	13½	—	—	6½	6½	6-39	18½	23½	16½	14½	73½	29½	49½
'40 ...	17½	—	—	8	8½	8-50	25½	23½	22½	19	114½	44½	66½
'41 ...	15½	—	—	7½	8½	8-45	24½	24½	22½	20½	118	41½	70½
'42 ...	16½	—	—	8½	9	9-25	26	26½	24½	23	118	44½	78½
'43 ...	16½	—	—	8½	9½	9-49	27	24½	34½	36	118½	48½	109½
Average													
1904-13	11½	—	—	9½	7½	6½	16	17	31½	31½	43½	26½	49½
1890-99	11½	—	—	6½	5½	5	13½	13½	25	24½	35	19½	38
'78-87	15	—	—	8½	6½	6½	15	17	35½	32½	40	23	46
'67-77	23	—	—	9	7	6½	16	18½	45	39	50	30	60

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

1922 ...	125	1,075	114	174	77	89	151	127
'23 ...	105	1,121	113	158	81	93	133	134
'24 ...	102	1,362	119	163	94	103	160	138
'25 ...	79	1,319	132	161	94	104	147	137
'26 ...	69	1,063	121	164	85	96	159	106
'27 ...	67	1,045	142	172	75	88	205	107
'28 ...	61	1,086	172	176	82	92	161	108
'29 ...	60	976	129	166	81	89	144	122
'30 ...	48	669	92	150	64	65	104	110
'31 ...	39	504	77	146	43	51	108	63
'32 ...	35	513	66	132	47	45	114	61
'33 ...	29	534	68	127	44	40	108	67
'34 ...	24	572	67	123	39	35	124	71
'35 ...	24	641	69	125	55	50	123	75
'36 ...	25	646	82	129	52	51	140	85
'37 ...	37	745	109	134	52	58	192	95
'38 ...	35	601	81	110	39	38	137	81
'39 ...	57	741	84	119	36	37	148	88
'40 ...	76	1,191	109	141	49	49	228	122
'41 ...	68	1,300	107	135	50	53	236	124
'42 ...	70	1,304	116	150	54	59	236	137
'43 ...	70	1,327	120	149	76	92	236	176

† Common New Style from 1921 to 1936. China, Extra "A" from 1937.

† Nominal.

Average Prices of Commodities—Contd.

No. of Article }	Year	41A ‡	41B ‡	41C ‡	41	42	43	44	45A	45B	35—46	20—45	1—45
		Petroleum *				Soda	Nitrate of Soda	Indigo	Timber			Sundry Materials	Grand Total
		Motor Spirit c.i.f. d. per imp. gall.	Kerosene (Burning Oil) c.i.f. d. per imp. gall.	Gas Oil c.i.f. d. per imp. gall.	Mean of 18A, 1B and 18C	Crystals s. per ton		Bengal, Good Consuming s. per lb.	Hewn, Average Import Price.	Sawn or Split, Average Import Price s. per load	Total	Total	
1922 ...	15-89	6-32	3-08	—	123	14½	9½	40½	117½	—	—	—	—
'23 ...	11-61	5-25	3-68	—	103	13½	7½	48	131½	—	—	—	—
'24 ...	10-14	5-69	4-28	—	101½	13½	6½	49½	122	—	—	—	—
'25 ...	9-98	4-96	4-22	—	100	13½	5½	47½	122½	—	—	—	—
'26 ...	9-21	5-66	4-25	—	100	13½	5½	48½	107	—	—	—	—
'27 ...	7-25	5-15	4-23	—	100	12½	5½	45½	107½	—	—	—	—
'28 ...	5-96	4-48	3-32	—	100	10½	5½	45½	111½	—	—	—	—
'29 ...	6-75	4-87	3-21	—	100	10½	5½	44½	107½	—	—	—	—
'30 ...	6-52	4-54	3-21	—	100	9½	5½	44½	102½	—	—	—	—
'31 ...	3-63	3-10	2-33	—	100	9½	5½	37½	83½	—	—	—	—
'32 ...	3-97	3-34	2-39	—	100	8½	5½	35½	75½	—	—	—	—
'33 ...	3-43	2-94	2-48	—	100	8½	5½	31½	75½	—	—	—	—
'34 ...	3-28	2-65	2-45	—	100	7½	5½	31½	79½	—	—	—	—
'35 ...	3-51	2-88	2-32	—	100	7½	5½	32½	73½	—	—	—	—
'36 ...	3-77	2-76	2-34	—	100	7½	5½	37½	78½	—	—	—	—
'37 ...	4-52	3-71	3-14	—	100	7½	5½	58½	103½	—	—	—	—
'38 ...	4-08	3-49	3-22	—	100	8	5½	61½	94½	—	—	—	—
'39 ...	5-00	3-71	3-61	—	100	8½	5½	57½	107½	—	—	—	—
'40 ...	5-79	5-68	5-31	—	100	9½	5½	106½	169½	—	—	—	—
'41 ...	6-97	5-95	5-93	—	100	13½	5½	191½	214½	—	—	—	—
'42 ...	7-77	7-00	7-07	—	102½	13½	5½	235½	236½	—	—	—	—
'43 ...	8-93	7-51	7-61	—	107½	13½	5½	269	246½	—	—	—	—
Average 1904-13					60	10½	3	38	56	—	—	—	—
1890-99					53	8½	4½	40	45	—	—	—	—
'78-87					62	12½	6	47	47	—	—	—	—
'67-77					92	14	7½	60	54	—	—	—	—

Index Numbers (or Percentages) of Prices, the Average of 1867-77 being 100

	†	†	†										
1922 ...	100	100	100	100	134	102	128	143	1,339	3,408	5,873		
'23 ...	73	83	92	83	112	96	103	157	1,263	3,467	5,785		
'24 ...	64	90	108	87	111	97	84	151	1,307	3,774	6,240		
'25 ...	63	79	106	83	109	96	79	150	1,292	3,691	6,120		
'26 ...	58	90	107	85	109	95	78	137	1,235	3,376	5,643		
'27 ...	46	82	106	78	109	90	76	134	1,276	3,311	5,477		
'28 ...	37	71	83	64	109	78	76	138	1,256	3,202	5,366		
'29 ...	42	77	81	67	109	73	76	134	1,190	3,047	5,143		
'30 ...	41	72	81	65	109	70	76	129	1,034	2,487	4,313		
'31 ...	23	50	60	44	109	65	76	106	890	2,094	3,673		
'32 ...	25	53	60	46	109	62	76	97	855	2,062	3,571		
'33 ...	22	47	62	44	109	60	76	94	837	2,121	3,529		
'34 ...	21	42	62	42	109	56	76	97	839	2,176	3,635		
'35 ...	22	46	60	43	109	54	76	92	871	2,298	3,745		
'36 ...	24	42	60	42	109	54	79	102	925	2,414	3,945		
'37 ...	28	59	79	55	109	56	79	142	1,081	2,821	4,581		
'38 ...	26	55	81	54	109	57	79	136	921	2,471	4,071		
'39 ...	31	60	91	61	109	58	79	145	964	2,663	4,247		
'40 ...	36	90	133	86	109	70	79	243	1,285	3,645	5,760		
'41 ...	44	94	150	96	109	93	79	356	1,438	4,004	6,379		
'42 ...	49	111	178	113	111	96	79	413	1,564	4,153	6,812		
'43 ...	56	119	199	122	117	96	79	452	1,715	4,354	6,978		

* Prior to 1922, Kerosene Burning Oil (in barrels), base period 1873-77; from 1922 c.i.f. values per imperial gallon of Motor Spirit, Kerosene, Burning Oil and Gas Oil, base period 1922.
 † Index-numbers not included in the general average.
 ‡ Nominal.

REPORT OF THE COUNCIL

For the FINANCIAL YEAR ended December 31st, 1943, and for the SESSIONAL YEAR ending June 20th, 1944, presented at the ONE HUNDRED AND TENTH ANNUAL GENERAL MEETING of the ROYAL STATISTICAL SOCIETY, held at the London School of Hygiene, W.C. 1, on June 20th, 1944.

THE Council have the honour to submit their One Hundred and Tenth Annual Report.

The roll of Fellows on December 31st, 1943, as compared with the average of the previous ten years, was as follows:—

Number of Fellows	1943	1933-1943
At beginning of period... ..	1079	1031
Lost by death, withdrawal or default	61	579
Elected or restored to the roll	121	627
At end of period... ..	1139	1079

In addition, there were 11 Honorary Fellows.

The Council regret to report that during the sessional year ended on June 20th, 1944, the Society lost by death the undermentioned Fellows:—

	Date of Election.
*à Ababrelton, Rev. R. de R., M.A.... ..	1907
cpHilton, Professor John	1920
cdHolland-Martin, Robert, C.B.	1898
d*Howard, Sir Henry Fraser, C.B., C.S.I., C.I.E.	1910
Kohnstam, Alfred	1942
cpMeston, Lord, of Agra and Dunottar, K.C.S.I., LL.D.	1932
Phillips, Sir Frederick, G.C.M.G., C.B.	1925
dp*Sale, Charles Vincent	1909
dStewart-Jones, Captain W. A.	1924
dStrakosch, Sir Henry, G.B.E.	1930
*Wells-Smith, Henry, F.C.A.	1889
White, Kenneth	1934
* Life Fellow.	c Served on Council.
d Donor to the Library.	p Contributed to Proceedings.

Lord Meston of Agra and Dunottar was elected President in 1932. His term of office included the year of the Society's centenary and he fulfilled the duties which devolved on him as host during the celebrations with conspicuous success. An Aberdonian by birth, he had a distinguished career as an Indian administrator which included the Lieutenant Governorship of the United Provinces from 1912 to 1918, and he was one of the representatives of India in the Imperial War Cabinet and at the Imperial Conference in 1917. His retirement in 1919 did nothing to diminish his interest in Indian affairs and his Presidential Address to the Society, given in November, 1932, was on Statistics in India.

Mr. Robert Holland-Martin, following in the steps of several members of his family, joined the Society in 1898. He was appointed Honorary Treasurer in 1916 on the death of his uncle, Sir Richard Biddulph Martin, who had filled that office since 1875. The great and always growing demands on Mr. Holland-Martin's time caused him to resign the Treasurership in 1934. In addition to his experience in financial affairs he brought to all he undertook a soundness of judgment, a generous sympathy, and a capacity for taking pains without appearing to do so. It may be said that he employed every moment of his time, most of them for the benefit of his fellows, and he will be greatly missed by all who knew him and worked with him.

The death of Professor John Hilton last August, at the age of 63, came as a shock, since he always seemed to be full of life and vigour. In former years he was a familiar figure in the Society. He often took part in discussions at the meetings and himself read three papers: "Statistics of Unemployment derived from the working of the Unemployment Insurance Acts" (1923); "Enquiry by Sample" (1924); and "Some Further Enquiries by Sample" (1928). The two latter papers are still in considerable demand and are generally regarded as constituting a text book on the particular subject. Mr. Hilton, as he then was, served on the Council from 1925 to 1927 and from 1928 to 1931, when he was appointed to the Chair of Industrial Relations at Cambridge.

Mr. Charles Sale had been a Life Fellow since 1909. He read a paper on "Some Statistics of Japan" in 1911. He was a man of wide interests, commercial and cultural, and had travelled much. He was a Chevalier of the Legion d'Honneur, and had had Orders conferred on him by the Sovereigns of Belgium, Denmark and Japan.

The Council has also to record the death, in August 1943, of Mr. John A. P. Mackenzie, who had served the Society with loyalty and devotion first as clerk and then as Librarian for over fifty years before his retirement at the end of 1939. Fellows who were in the habit of using the Library at Adelphi Terrace will recall his detailed knowledge of its contents and his zeal in giving assistance to enquirers.

During the Session 1943–44, the candidates named below have been elected Fellows of the Society:—

Balchin, Nigel Marlin, Lt.-Col.
Ballantine, Cecil Dudley.
Barna, Tibor.
Bellerby, John Rotherford.
Benham, Charles Edward, A.I.A.
Bergman, Uri.
Bird, Basil Martin.
Blakes, Albert George.
Blau, Gerda.
Bodington, Stephen.
Bourdillon, Francis Bernard.
Brend, Oliver Louis.
Britton, Dennis King, B.Sc.

Browning, Horace Edmund, B.Sc.
Bryce, James Edward, B.Com.
Bull, Joseph Leonard.
Cessford, Hugh McDonald.
Clements, John.
Corbett, Mrs. Winifred Margaret.
Crichton, Alexis, Captain.
Crowther, Geoffrey.
Daly, James.
Davies, Robert Leslie.
Day, Stanley Arthur.
Devons, Ely.
Dodd, Alfred Herbert, M.A.

Eeman, Peter Derek, M.B., B.Ch.	Moser, Claus A., B.Sc.
Egner, William Edward.	Mowatt, David.
Fairmont, Moss.	Munro, Harold Neville.
Finlay, Robert Arthur, A.I.A.	Nawrocki, Zygmunt, Flying Officer.
Fisher, Allan George Bernard.	Newman, Dennis.
Frankel, Henryk.	Osborn, W. T., B.Sc.
Gábor, André.	Palca, Henry, B.A.
George, Cyril Henry, Major.	Perrott, Ivan Brian.
Goldmann, Josef.	Philpot, Harold Radcliffe, Squadron Leader.
Grimsey, Alfred Herbert Roberts.	Pocock, B. M., B.Sc.
Grodzicka, Dr. Ewa.	Pomeroy, Robert William.
Grodzicki, Dr. Ludwik.	Reddaway, William Brian.
Gryziewicz, Stanislaw.	Reeve, Eric Cecil Raynold.
Hamilton, Eugene L., Captain.	Richardson, John Thomas.
Harries, John Mostyn.	Rostas, Dr. L.
Haycocks, Herbert Weston, F.I.A.	Saunders, Eric George.
Haydock, Jack.	Schwab, Max Henry.
Herdan, Gustav.	Sealy, Eldred Hutchinson.
Hill, Charles Joseph Walter.	Sharpston, Charles Henry.
Hills, Richard Edward.	Silverman, Rodney, B.Sc.
Horabin, Thomas Lewis, M.P.	Smith, Thomas Harold.
Horton, W. H., B.Sc.	Smith, Wilfred.
Hunt, Bishop C.	Steinbock, Efraim.
Ilersic, Alfred, B.Com.	Stephens, John Newton, M.I.E.E.
Jackson, James Sykes.	Sur, Atul K.
Joyce, James Avery, B.Sc.	Sutton, Charles Thomas.
Kendall, David George.	Talbot, Ernest Vivian.
Kenney, Harold, M.A., A.M.I.Mech.E.	Tatford, Frederick Albert.
Kraay, Casper Alexander.	Taylor, Arthur Wood.
Lathbury, Mrs. Kathleen, F.I.C.	Taylor, Mrs. Elizabeth M.
Lawson, Robert Edward, A.C.I.S.	Thomas, Brinley, M.A., Ph.D.
Leser, Conrad Emanuel Victor.	Traill-Hill, Cecil James.
Lewsley, Bernard John, B.Sc., A.C.E.E.	Vogel, Michael Tobias.
Lockett, Gordon Harrison.	Watson, Anthony Heriot.
Mann, Mrs. Margaret Reid.	Wells, Sydney John Williams.
Margulies, William, B.Com.	Williams, Thomas Charles, B.Sc., A.I.C.
Matthews, John William.	Willshire, Noel Alfred Dennis.
Merrington, Mrs. Maxine P. M.	Wright, Arthur Charles.
Mitchell, Joan Eileen.	Wright, Wallace Wheldon.
Mitra, Probodh Chandra.	Wurm, Frederick Joseph.
Moore, Edward John.	Yeabsley, Richard Ernest, C.B.E.
Morrell, Arthur John Havant, M.A.	Zweig, Konrad.
Morris, Howard Walter, M.A.	
Morris, William.	

Corporate Representatives.

Ehrlich, Josef,	<i>representing</i> the Czechoslovak Board of Education.
Flack, George Ellis, M.A.,	<i>representing</i> University College, Nottingham.
Gibson, J. L., B.A.,	<i>representing</i> the National Council of Building Material Producers.
Heinemann, Margot,	<i>representing</i> the Labour Research Department.
James, John Richings,	<i>representing</i> the Geographical Section, The Admiralty.

Kač, Václav,	<i>representing</i> the Czechoslovak Ministry of Agriculture.
Kemp, David, M.A.,	<i>representing</i> the British Engineers' Association.
Scribens, Frank Thomas,	<i>representing</i> Edmundson's Electricity Corporation, Limited.
Tyerman, Donald; Bird, R. E.; Desbrow, Mrs. R. L.; Andrews, Mrs. V.; Self, D. O.,	} <i>representing</i> the Economist Newspaper.
Tyrwhitt, Mary Jaqueline,	
Wiesner, René Alexander,	<i>representing</i> the Association of Planning and Regional Reconstruction.
	<i>representing</i> the Czechoslovak Ministry of Public Works.

During the present Session, the number of Fellows has increased to 1240, the largest in the history of the Society.

In 1943 the Society held an inter-sessional meeting on October 12th when Sir William Beveridge delivered an Address on Social Security: Some Transatlantic Comparisons, for which he had been unable to find time during his term of office as President.

The meetings of the Session proper were held in March, April, May and June. The papers were:—

SNOW, Dr. E. C., C.B.E. (Presidential Address). International Comparisons of Industrial Output.	(March 31st, 1944.)
FLORENCE, Professor P. SARGANT. The Selection of Industries for Dispersion into Rural Areas.	(April 18th, 1944.)
BOX, KATHLEEN, and GEOFFREY THOMAS. The War-time Social Survey.	(May 16th, 1944.)
SILVEY, R. J. E. Listener Research.	(June 20th, 1944.)

The Industrial Applications Group continued its activities during the Session. Five meetings were held and were well attended. The subjects discussed were as follows:—

1943.

October 8th	... The installation of quality control in a factory; opened by Mr. A. W. Swan.
November 19th	... Machine tool performance as revealed by quality control technique; opened by Mr. A. Brown.

1944.

January 14th.	... Quality supervision by sampling inspection; Mr. H. Rissik and Mr. A. W. Swan.
March 17th	... Quality control technique—time study, costing and bonus systems; opened by Mr. A. S. Wharton.
May 10th ...	... Analysis of variance applied to the study of machine tool performance; Mr. W. A. Bennett and Dr. J. W. Rogers.

Members of the Industrial Applications Group also took part in a number of meetings on Quality Control arranged by the Manchester Statistical Society.

The Report of the Committee on Official Statistics was presented to the Council at their meeting in September 1943. With slight amendments it was unanimously adopted and was subsequently forwarded to H.M. Treasury as a Memorandum on Official Statistics. The full text was printed in the *Journal*, Part II, Vol. 106 (1943), and was also separately issued for distribution and sale. There was a strong demand for copies from various organizations and individuals, which indicated that the Memorandum aroused widespread interest.

On February 22nd a question was put in the House of Commons by Mr. Alfred Edwards, the Member for Middlesbrough, who asked the Prime Minister whether he had considered the Memorandum on Official Statistics published by the Royal Statistical Society, of which a copy had been sent to him, and whether he could make a statement. The Prime Minister replied: "This valuable Memorandum is being carefully considered by the Departments concerned. They will probably wish to discuss it with the representatives of the Society."

In the event, the Treasury invited representatives of the Society to confer with them, and on March 30th a deputation, consisting of the President and the other members of the Official Statistics Committee, met officers of the Treasury and of certain other Ministries.

The official representatives stated that the Memorandum had been of great help to the Government, and that its main recommendations were being favourably considered. They asked for further advice in connection with the recruitment of statisticians to the Civil Service and the status of statisticians within that service. Representatives of the Society expressed their views on these subjects and subsequently reported to the Council, which approved the advice given.

In recent years it has become increasingly clear that a need exists for some means of giving status to persons engaged in statistical work. The Society has constantly been asked how such status could be obtained, and there is no doubt that employers, official and unofficial, have met with difficulty in assessing the qualifications of applicants for statistical posts because of the lack of an adequate standard.

The Council, therefore, appointed a Committee in June 1943, to consider the best method of conferring a definite status on competent statisticians. The Committee held eight meetings and their final Report setting forth the scheme decided upon was, with slight amendments, adopted by the Council in April 1944. It is proposed that the Society should assume the additional functions of an examining body and should confer Diplomas and Certificates in Statistics.

Copies of the Report have been sent to Fellows and at the Annual General Meeting they will be asked to approve of these proposals and to authorize an application to the Privy Council for a Supplemental Charter in order to enable them to be put into effect. It should be added that the proposals which Fellows are being asked to endorse do not affect their status or the method of their election. The Diploma and the Certificate would not be confined to Fellows and Fellows would not be required to possess them.

The Committee's terms of reference were subsequently expanded and the membership appropriately enlarged in order that they might examine and report to the Council on the teaching of statistics and might make recommendations

for any improvements or developments in that direction. This task is now in progress.

The Library Committee, which had not been re-appointed since 1932, was revived during the past Session, the members being Drs. A. Bradford Hill and C. Oswald George (Honorary Secretaries) and Mr. M. G. Kendall. Among the steps they have taken have been an improvement in the lighting of the Reading Room, the provision of a suggestions book for the use of readers, and the printing of a letter in the *Journal* inviting Fellows to submit any suggestions they would like to be considered. The Committee have also been considering the question of installing calculating machines for the use of Fellows, and a beginning has been made by the provision of a Madas machine.

The Library continues to be greatly used; requests for permission to consult books unavailable anywhere else are constantly received and are acceded to as far as possible. The Society's collection of foreign official statistics is proving of especial value to those working for the exiled Governments now in London. The number of persons using the Library in the year ending May 31st, 1944 was 2,115 compared with 1,434 in 1943. In the same period 539 works were added to the Library compared with 508 the year before and 2,700 volumes were borrowed by 1,099 Fellows against 2,805 by 975 Fellows in the previous year.

The abstract of the Treasurer's Accounts. viz., the Statement of Income and Expenditure for the year 1943 and the Balance Sheet as at 31st December, 1943, together with the report of the Auditors thereon, are given in Appendices A and B.

Income, at £2,967, was £45 greater than in 1942; annual subscriptions increased by £143, but sales of the Supplement fell by £86 as no Supplement was issued in 1943. Expenditure fell by £75 to £2,773. There was an excess of income over expenditure of £194 in 1943 as compared with an excess of £74 in 1942. At the end of 1943 the Accumulated Fund of the Society amounted to £7,703.

The Fellows named below (nominated in accordance with Bye-law 14) are recommended for election as President, Council, and Officers of the Society for the Session 1944–45:—

President

Ernest Charles Snow, C.B.E., D.Sc.

Council

Sir Percy Ashley, K.B.E., C.B.
H. Champion.

*Henry Clay.

*A. M. Carr-Saunders.

L. R. Connor, M.Sc.

B. P. Dudding, M.B.E., Ph.D.

Major P. G. Edge, O.B.E.

Sir William Elderton, C.B.E., F.I.A.

Barnard Ellinger, C.B.E.

Dorothy P. Ellinger.

C. Oswald George, Ph.D.

*Sir Gwilym Gibbon, C.B., D.Sc.

*D. V. Glass.

R. G. Glenday, M.C.

P. N. Harvey, C.B., F.I.A.
 R. G. Hawtrey, D.Sc.
 David Heron, D.Sc.
 A. Bradford Hill, D.Sc., Ph.D.
 *J. O. Irwin, Sc.D., D.Sc.
 Leon Isserlis, D.Sc.
 M. G. Kendall.
 Lord Keynes, C.B., F.B.A.

Professor E. S. Pearson, D.Sc.
 Professor Arnold Plant.
 George Rae, D.Sc.
 *E. C. Rhodes, D.Sc.
 *Richard Stone.
 L. H. C. Tippett.
 *G. Ronald White.
 A. S. Windett.

Those marked * were not Members of Council during the preceding Session

Honorary Treasurer

David Heron, D.Sc.

Honorary Secretaries

Leon Isserlis, D.Sc.

A. Bradford Hill, D.Sc., Ph.D.
 C. Oswald George, Ph.D.

On behalf of the Council,

E. C. SNOW,
President.

L. ISSERLIS,
 A. BRADFORD HILL
 C. OSWALD GEORGE } *Hon. Secretaries.*

June 4th, 1944.

APPEN

STATEMENT OF INCOME AND EXPENDITURE

EXPENDITURE.

1942				1943			
£	s.	d.		£	s.	d.	
			Rent				
380	0	0		380	0	0	
206	17	7	House Expenses	201	16	6	
			Salaries and Wages (including contribution to Staff Super- annuation Scheme)	1,033	5	7	
1,028	2	10					
189	0	0	Pension and Allowance	134	1	1	
			Meetings:—				
54	11	1	Ordinary and General	67	5	7	
1	17	3	Industrial Applications Group	7	1	3	
56	8	1	Publication and Distribution Expenses:—				
			Journal and Reprints	574	12	11	
455	18	9					
109	11	9	Supplement	9	11		
565	10	6	Library:—				
			Books	46	9	6	
38	8	8					
41	15	0	Binding				
80	3	8	Insurance				
20	17	6	Stationery and Miscellaneous				
			Printing				
39	18	7					
48	13	2	Postage and Telephone				
7	14	1	Miscellaneous Items				
36	15	0	Auditor's Fee [1942]				
129	7	6	War Damage Insurance				
			Emergency Transport and Stor- age				
46	2	2					
12	12	0	Fire-watching				
2,848	2	11	Balance carried to Accumulated Fund: Excess of Income over Expenditure for the year 1943	2,772	18	3	
74	5	2					
2,922	8	1	Amount carried to Life Compo- sition Fund	2,967	3	3	
115	10	0					
£3,037	18	1		£3,072	3	3	

DIX A.

FOR THE YEAR ENDED 31ST DECEMBER, 1943

INCOME.														
1942												1943		
£	s.	d.										£	s.	d.
1,634	17	0	Annual Subscriptions	...	...	...	...	...	...	...	1,777	13	0	
664	6	8	Sales of Journal and Reprints	...	...	...	...	...	...	...	654	12	0	
1	15	0	Journal Advertisements	...	...	...	...	...	...	...	7	15	0	
108	8	7	Sales of Supplement	...	...	...	...	...	...	...	22	15	2	
4	9	4	Sales of other Publications	...	...	...	...	...	...	...	16	6		
50	0	0	Contribution from Royal Economic Society	...	...	...	...	...	...	...	50	0	0	
458	11	6	Dividends and Interest (gross)	...	...	...	...	...	...	...	453	11	7	

APPEN

BALANCE SHEET AT

1942				1943			
£	s.	d.	£ s. d.	£	s.	d.	£ s. d.
				LIABILITIES.			
				Annual Subscriptions received			
				in advance			
				81 18 0			
				Payments for Journal and			
				Supplement received in			
				advance			
				210 14 2			
				Sundry Creditors			
				214 18 2			
				Life Composition Fund:—			
				Balance at December 31st,			
				1942			
				2,294 5 0			
				Add: Life Composition Fees			
				received in 1943			
				115 10 0			
				2,409 15 0			
				Accumulated Fund of the			
				Society:—			
				Balance at December 31st,			
				1942, per last Accounts ...			
				7,434 14 10			
				Add: Excess of Income over			
				Expenditure for the year			
				1943, per annexed State-			
				ment			
				74 5 2			
				7,509 0 0			
				10,426 5 4			
				Building Fund (per contra):—			
				Balance at December 31st,			
				1942			
				953 3 9			
				Add: Income for year 1943...			
				36 14 1			
				989 17 10			
				Frances Wood Memorial Fund			
				(per contra):—			
				Balance at December 31st,			
				1942			
				401 0 2			
				Add: Income for year 1943...			
				26 15 3			
				427 15 5			
				£11,843 18 7			
				£12,240 8 3			

Notes.—No value is placed in the Accounts on (1) Journals and other Publications in stock, (2) Books in Library, and (3) Pictures, Furniture and Equipment.

DIX B.

31ST DECEMBER, 1943

[illegible]

REPORT OF THE AUDITORS

We have examined the foregoing Statement of Income and Expenditure and Balance Sheet with the Books and Records of the Society. We have verified the Investments and Cash appearing in the Balance Sheet. We report that the above Balance Sheet is, in our opinion, properly drawn up so as to exhibit a true and correct view of the state of the affairs of the Society, according to the best of our information and the explanations given to us, and as shown by the Books and Records.

PLENDER, *Chartered Accountant.* Auditor.
P. GRANVILLE EDGE } Honorary
F. E. RICHMOND } Auditors.

PROCEEDINGS OF THE ONE HUNDRED AND TENTH ANNUAL GENERAL MEETING
OF THE ROYAL STATISTICAL SOCIETY, HELD AT THE LONDON SCHOOL OF
HYGIENE AND TROPICAL MEDICINE ON TUESDAY, JUNE 20TH, 1944, AT
5 P.M.

THE CHAIR was taken by the President, DR. E. C. SNOW, C.B.E.

THE HONORARY SECRETARY read the notice convening the meeting.

THE CHAIRMAN announced that the name of one Fellow, whose subscription had been unpaid for some years, was being removed from the roll as that of a defaulter, but that others in arrear were not being dealt with at present, owing to difficulties of communication.

A ballot was taken for the election of the President, Council and Honorary Officers for the Session 1944-1945, Miss Dugdale and Mr. Finney being appointed scrutineers. It was subsequently announced that all those nominated had been elected.

The Chairman presented the Report of the Council for the financial year 1943 and for the Session 1943-44, and drew attention to the principal features. He referred especially to the paragraphs describing the work of the Committee on the Status of Statisticians. A number of Fellows had indicated that they would like to discuss it at some length. Since, however, the Annual Meeting was to be followed by an Ordinary Meeting it would not be convenient to have a long discussion now. He suggested that another meeting should be arranged at which the report could be discussed.

The Chairman, on behalf of the Council, expressed their appreciation to the Honorary Treasurer, Dr. Heron, for the great amount of work he had put in during the past year, not only with respect to the Society's finances but in the assistance he had given to the Special Committees.

He then moved the adoption of the Council's Report.

DR. HERON outlined the financial position shown in the tables and seconded the adoption of the Report.

MR. R. G. FORRESTER asked that more time should be allowed for the Annual General Meeting in order that the Report of the Council might be adequately discussed.

After discussion the Chairman suggested that the most satisfactory procedure would be to adjourn the Meeting to a later date, at which a full discussion of the Report of the Council could take place.

MR. LEAK proposed that item 3 on the agenda should be taken before the adjournment. This proposal was seconded, put to the Meeting and carried.

THE CHAIRMAN then moved:—

“That this Meeting desires that a Petition be presented to the King's Most Excellent Majesty in Council praying that His Majesty may be graciously pleased, in the exercise of his Royal Prerogative, to grant to the Society a Supplemental Charter giving to the Society such powers as may be deemed necessary to enable the Society to give effect to the recommendations comprised in the Report of the Committee on the Status of Statisticians as amended and adopted by the Council and circulated to Fellows together with the notice of the Meeting, and that the Council be

authorised to have the said Petition prepared and presented and to take such steps as are necessary to procure the granting of the necessary Supplemental Charter."

Mr. Kendall seconded the resolution.

After some discussion, the Chairman put the resolution and it was carried by 38 votes to 12.

The Chairman emphasized that the passing of the resolution would not preclude full and free discussion of the Petition, which would be laid before a Special General Meeting.

The Meeting was then adjourned to some future date to be subsequently arranged.

REJOINDER TO MESSRS. LEAK AND MAIZELS

By R. C. GARY

MESSRS. Leak and Maizels and I agree that the concept of volume of net output presents certain difficulties. We differ for the reason, I think, that Messrs. Leak and Maizels consider that these difficulties are in the main theoretical, whereas I am convinced that they are entirely practical—unreliability of basic data, changes in qualities of goods produced (affecting the unit value index number), etc. I deal with the three main points in the note in the following paragraphs.

1. *The effect of duplication.* I cannot accept the assumptions in regard to duplication implied in the first two sentences of the second sub-paragraph. It is implicitly assumed in my paper that the unpriced element is *on the whole* of unimportant dimensions (which is the case with the Irish data) and I do not think that Messrs. Leak and Maizels are justified in introducing it for their argument in connection with duplication. If one knows the total value of duplication (as Messrs. Leak and Maizels assume for the purpose of their calculation), surely one knows the commodities concerned and, accordingly, their price movement, and there is no reason whatever for assuming that the price movement of the duplicated sector is the same as the general price movement for products and materials in the industry. The assumption, in a particular application, amounts to this: if in the woollen industry there is duplication at the tops stage, the price movement on the one hand is that of materials generally (principally raw wool and tops) and on the other hand that of products (principally piece goods and tops), which just does not make sense. The correct theoretical approach is as follows: If p' and p'' be the unit value index-numbers appropriate to the duplicated items using duplicated quantities in the earlier and later periods respectively—it is not even necessary to assume $p' = p''$ —the formula is then

$$N = \sqrt{\frac{V_1 - v_1}{V_0 - v_0} \cdot \frac{\left(\frac{V_1}{P} - \frac{d_1}{p''}\right) - \left(\frac{v_1}{p} - \frac{d_1}{p''}\right)}{(V_0 P - d_0 p') - (v_0 p - d_0 p')}} \\ = \sqrt{\frac{V_1 - v_1}{V_0 - v_0} \cdot \frac{P - \frac{v_1}{V_0 P - d_0 p'}}{P - \frac{v_1}{V_0 P - d_0 p'}}}$$

which is independent of the d and identical with the formula used in my paper. The effect of duplication is nil. No more regard need be paid to duplication in the case of *volume* than of *value* of net output.

On a point of detail, the yardage figures quoted in the paper for the Shirt-making industry were after making careful allowances for materials used in the production of pyjamas, collars, etc. Particular attention was directed to this, by no means "typical," industry because of the peculiarity of the arithmetical results, which peculiarities were not due to the use, as for all industries, of unit values because application of the true wholesale price index-numbers (referred to in paragraph 3 below) did not materially affect the results; and, as it happens,

no industry more closely conforms to Messrs. Leak's and Maizels's ideal of well-differentiated descriptions in both materials and products.

2. *Stock valuation.* There are many ways of dealing with stocks in the determination of net output. The logic of the method adopted in Ireland is that if gross output is "the net selling value of all goods produced during the year whether sold or added to stock" materials represent "purchased materials actually used for production and repair work done during the year (whether purchased during the year or taken from stock held at end of previous year)." Assuming that the instructions are carried out in the filling up of the forms, I do not see how any difficulty arises on this head in the determination of volume of net output.

3. *The use of wholesale price index-numbers.* I am sorry that I completely disagree with Messrs. Leak and Maizels in their contention in this paragraph. The difference between us, no doubt, arises partly from the fact that they have in mind the practical difficulties of application in a great industrial country, whereas my background is the comparative simplicity of Irish conditions. I am quite satisfied that sufficiently accurate sectional wholesale price index-numbers can be devised which can be used for deflating values of products which will, accordingly, yield volume index-numbers which will take account of changes in quality. Just before the war arrangements were being made in Ireland systematically to increase the number of quotations included in the wholesale price index series as new commodities of significant value appeared on the market, and it was proposed, further, to make the necessary adjustments in weights from year to year, but the project had to remain in suspense for the usual reasons; and it is intended to proceed with this scheme with the return of something like normal conditions. War-time experience with industrial and import unit value index-numbers has made apparent the need for such a change. If, between consecutive years, production of motor-cars changes from 1,000 at £200,000 to 800 at £240,000, should the volume be regarded as declining in the ratio of 1,000 : 800, or should the volume trend be determined from the values deflated by a wholesale price index-number for motor-cars of unchanged quality? In this particular case, even if it were impossible to compute a suitable wholesale price index-number (which is not admitted), the author would personally prefer to seek "the opinion of the trade," or even take value rather than number as an indicator of volume—in other words, to assume price unchanged: at normal times prices change slowly for highly manufactured products.

In the past most countries have been far too niggardly in the scope and coverage of their wholesale price series. A reorientation of attitude would appear necessary. Instead of selecting for wholesale pricing some hundreds of commodities, as "typical" or "important" or "basic," which to a considerable extent prejudice the result of the calculations, one should, in theory at least, collect prices of *all* commodities, at *all* stages of production and exchange, and reject those which because they are insignificant in value or because they are too subject to variation from time to time in quality standard, etc.; at any rate the principle of rejection should be neutral to the purpose for which the figures are to be used. Whatever doubts may be entertained as to the usefulness, or even the validity, of *general* wholesale price index-numbers, there cannot be two opinions as to the essential usefulness of *sectional* wholesale price index-numbers—i.e., index-numbers of prices of commodities "observed

at definite points in the economic process " *—*e.g.*, at the back and front doors of individual industries, provided always that there is a generous profusion of prices data.

I may add that the principal reason why I do not consider that wholesale prices should be used for the deflating of value of *materials* is that one does not know with any precision the date of purchase of these materials.

Even though I differ rather drastically from Messrs. Leak and Maizels on these points may I add that I found their commentary most interesting, stimulating and provoking!

* R. C. Geary, *op. cit.*, *supra*, p. 18.

REVIEWS OF STATISTICAL AND ECONOMIC BOOKS

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1.—*Theory of Games and Economic Behaviour*. By John von Neumann and Oskar Morgenstern. Princeton University Press and Oxford University Press. 66s. 6d.

This unusual book is based on the thesis that the economic man attempts to maximize his share of the world's goods and services in the same way that a participant in a game involving many players attempts to maximize his winnings. The authors point out that the maximization of individual wealth is not an ordinary problem in variational calculus, because the individual does not control, and may even be ignorant of, some of the variables. The general theory of social games, in their view, offers a simplified conceptual model of economic behaviour, and a study of that theory can do much to throw light on certain basic concepts of economics, notably that of utility.

The opening chapter of the book introduces this basic idea and seeks to establish the dualism between standards of economic behaviour and strategies in social games. Once this is done the book turns to the mathematics of games themselves for about 500 pages, returning to economic interpretation at the end. Thus the bulk of the work is a complete account of the theory of *Gesellschaftsspiele* developed by von Neumann himself in the last seventeen years, and contains a good deal of material now published for the first time. The economic interpretation of the results is much shorter.

Although the mathematics are self-contained, in the sense that the theory is developed from primitive ideas, an extensive use is made of set-theory, functionals and, of course, mathematical notation. From the point of view of familiarity with the notation alone it is doubtful whether anyone but a fairly competent mathematician would follow the argument and appreciate what the authors are driving at. This was unavoidable, but seems a pity, as the book will remain closed to those economists who are unfamiliar with mathematical ideas and methods; whereas there are many stimulating suggestions in it for the theoretical economist. In the theory of games, for example, monopoly and duopoly appear as the simplest cases and free competition as a limiting case for a large number of players, which seems closer to current economic thought than the traditional method of treating the subjects in the contrary order. Again, the equations of classical economics made no allowance for the stochastic element, whereas in the formulation of a strategy due account can be taken of it on a rational basis.

One would like to see the economic side of the subject developed further.

M. G. K.

2.—*World Wheat Production: its Regional Fluctuations and Inter-regional Correlations*. By V. P. Timoshenko. Food Research Institute, Stanford University, California. 11" x 8". [151] pp. 3 dollars.

This is an issue in volume form of three of the Stanford Wheat Studies published during 1942-4. Mr. Timoshenko has put a great deal of work into these studies, which form a valuable addition to our knowledge of crop variation. His book will be useful not only for what it proves, but for what it disproves.

In Part I the author considers the existence of "cycles" in recorded wheat yields. His data are drawn from all over the world and extend back to various dates, the earliest being 1815 (for France), but the modal date being about 1875. He works first of all on intervals between peaks in his series, but very wisely considers the distribution of intervals by length rather than the mean-interval. These distributions are then compared with those based on a random series, and there appears to be no significant difference.

This is a very important result. Mr. Timoshenko then considers mean-distances between upcrosses and also distributions of peaks and upcrosses in production (as distinct from yield). The tests he uses are admittedly rather insensitive, and one would like to have seen them reinforced by the calculation of serial correlations, but the general inference seems clear that apart from trend almost all, if not the whole, of the observed fluctuation can be accounted for as random variation from year to year. Cycles in the systematic sense are, to say the least, not proven.

At one point Mr. Timoshenko falls from grace rather heavily, and though his general standard disarms criticism and his own results are not seriously affected, the procedure he follows is so undesirable that a few words of general protest may be excused. Noticing that certain peaks of his series are only ripples, he "edits" it by omitting some of them and, of course, arrives at a greater mean-period by doing so. Now, as a general method of arriving at the descriptive properties of the series this is unexceptionable—he is not interested in ripples, and so he omits them. But it is extremely dangerous in theoretical investigations; he lays down no rule on which the rejection is to take place; and what is worst of all, he says, "We select for more detailed presentation cycles identified by this method because the segregation of minor movements in yields according to it was made with more deliberation and less mechanically than" the method of counting upcrosses. Nothing could be more dangerous in the study of oscillatory movements than to give the observer any discretion in choosing which peaks he regards as important. Mechanical methods are not free from difficulty, but they are at least objective. Subjective methods leave the length of "cycles" at the observers' mercy. To do Mr. Timoshenko justice, he indicates which peaks he has rejected, and has exercised his self-appointed discretion in a reasonable way; but the principle is surely a very bad one.

In Part II, Mr. Timoshenko considers some regional aspects of variability. On the basis of a coefficient of variation he divides the wheat-growing areas in the world into two groups: those of smaller and those of greater variability. Generally speaking (though there are some qualifications), the greater variation takes place where the mean yields are highest and the climate is of the continental type. There are a number of other conclusions, to which there is unfortunately no space to refer in detail, but which will be of general interest not only to the agricultural statistician but to the theorist as well. In particular there is some valuable material for study on the size of the sampling unit in relation to the precision of estimates; for example, the variability of the whole continent of Australia is nearly as large as that of each of the several constituent regions.

Part III of the study deals with inter-regional correlations in wheat-yields and outputs. In certain countries there are high correlations between regions, as in the case of Australia which has just been mentioned. In others there are insignificant or negative correlations, as in the U.S.A. Broadly speaking there is lack of correlation among variations in yields and outputs of the principal

wheat-exporting countries, which results in a relative stability of total production. Mr. Timoshenko proceeds, "It is hardly possible to speak of cycles in world crop production. If there are fluctuations in world crop production that may be called 'cycles' they should result from the summation of independent random variations, which are characteristic of regional yields of various crops, rather than be produced by certain factors common to most crops in most of the regions of the world."

The whole work is of the high standard we expect of the Food Research Institute at Stanford University, and can be studied with profit by any statistician or economist, agricultural or otherwise.

M. G. K.

3.—*Economic Destiny*. By R. G. Hawtrey. London: Longmans, 1944. 8½" × 5½". ix + 388 pp. 21s.

This book contains the results of over thirty years' reflection on the problems of economic theory by one of the founders of the modern monetary approach to the trade cycle and allied problems. Its purpose is to trace our economic troubles to their sources and to subject the various proposals for change to critical examination. No attempt is made to follow diagnosis with prescription, but rather to describe the underlying forces by which, whatever changes are instituted, the future will ultimately be shaped. The far-reaching influence exercised on economic thinking by Mr. Hawtrey's writings has not received the recognition it deserves. One reason perhaps is that he has preferred to adhere to a method of approach of his own rather than be drawn into the maelstrom of the Beveridge and Keynesian schools of thought. He regards the prevalent belief of these economists that depressions are caused by excess savings as being in direct conflict with the facts. He accordingly refuses to look to public works and unbalanced budgets for the cure of general unemployment, believing that banking policy and the rate of discount, if properly adjusted to the conditions of our time, can provide a satisfactory solution. He insists that it has not been sheer perversity that has led central banks to inflict deflation on the world. They have always done so to correct a pre-existing expansion that has been allowed to flow too far. Similarly, he does not believe that the experience of the war affords a guide to what will be practicable in a time of peace. There is no true parallel: The singleness of aim in time of war is the response to an immense calamity, the need to face loss and injury in order to avert what is held to be a still greater evil, subjection to a hostile power. The loss and injury are common to all and understood by all. The trouble about work for welfare in peace-time is that, while it, too, should be co-operative, there is no singleness of aim. "The multiplicity of welfare is fundamental." The Russian Five-Year Plan, it is true, is an example of a great national effort concentrated at heavy cost on a single comprehensive purpose. But it was an exceptional economic effort. "The Five-Year Plan in fact was not only the extension to the Soviet Union of the industrial revolution which had transformed the economic condition of Europe in the nineteenth century, but it was also a great rearmament programme." The future need is likely to be, not a spirit such as may be elicited through a great wave of enthusiasm, but a sustained effort.

While he believes that the competitive system can be made to work if the economic principles through which it works are understood, "a repetition of the blunders of the interval between 1918 and 1939 might lead either to a summary imposition of collectivism or to a totalitarian system which could only be provisional." After the present war there will be great changes in requirements. The reinstatement of the world's capital equipment after the destruction, and the arrears of capital outlay and maintenance entailed by the war, will call for an effort comparable to that of the Russian Five-Year Plan. "It may be that organization from the centre little less complete than that imposed in time of war may be necessary."

One very effective way of exercising control, Mr. Hawtrey suggests, would be for the Government to take over the functions of the wholesale dealer, including the selling side of the producers who supply retailers direct. Thus

the Government would take over the responsibility of giving orders to producers, of regulating the stocks held at wholesale and of quoting the prices charged to retailers and paid to producers.

At the same time, if the transition from war to peace is not to be struck with a paralysis involving the process of reconstruction in desperate delays, it is desirable to allow as much scope as is consistent with a policy of foresight to private enterprise. Profit-making should be allowed to continue.

Most of his suggestions are wise and helpful, but when Mr. Hawtrey concludes his book by asserting that "it is practicable to maintain a sufficiently stable flow of money, and, if that is achieved, the worst troubles will be overcome. Not only can trade depressions and general unemployment be avoided, but the dislocation of international trade and the foreign exchange can be kept within manageable limits," he will find many of his readers wishing that he had made closer contact with the world of affairs.

This book is the product of a mature mind that has pondered long over the economic complexities of our time. It should be read in an interval of leisure when time permits of pauses to enable the reader both to re-read passages and to test out his own ideas against the background of Mr. Hawtrey's analysis. And even when he may feel disposed to disagree strongly—as he may well do on the human aspect if he be a practical man—he cannot fail to come away with a clearer appreciation of the forces destined to shape our economic future than he had before.

R. G.

4.—*Full Employment in a Free Society*. By Sir William Beveridge. London: Allen and Unwin. 1944. 8½" × 6½". 429 pp. 12s. 6d.

Everybody interested in the study of social affairs can look forward with pleasure to reading this stimulating and important book. It takes the form of an unofficial report on the problem of securing and maintaining full employment, and is really a sequel to the author's official report on Social Security, the two together presenting a complete phase of social policy.

The author starts with the thesis that since the maintenance of full employment is not within the powers of individual employers to accomplish, the duty of securing this condition must be shouldered by the State. The argument relates chiefly to the post-reconstruction period, and full employment is defined as a state of affairs in which there are slightly more vacant jobs than unemployed people, so that those who lose jobs can find new ones with a minimum of delay. The aim is to reduce unemployment to a maximum of 3 per cent., and it is claimed the upward pressure upon money wage-rates likely to result from the increased bargaining strength of labour will be eased by rising productivity and kept in bounds by the universal acceptance of a system of arbitration. In a word, it is assumed that the hearty co-operation of the workers will be secured by their common interest in the social ideal of full employment.

The methods of achieving full employment are restricted to those which are compatible with a free society. It is assumed that the "direction" of workers under the Essential Works Order will have ceased, leaving freedom of choice of occupation, and that the individual will be free to spend and to save as he wishes. It does not necessarily mean private ownership of the means of production, since this has never been a widely enjoyed type of freedom, although the author believes that full employment can, in fact, be attained with private enterprise at the helm in most industries, with the reservation that, as a matter of policy, it might be desirable to increase the segment of industry coming under public control.

In the main, it is shown that the high levels of pre-war unemployment were due to the ineffective demand for the products of industry, with imperfect mobility of labour and with certain unsatisfactory features in the organization of the labour market as contributory causes. The remedy proposed is a planned economy which socializes demand sufficiently to secure the maintenance of adequate outlay at all times. The location of industry is to be controlled, and, to some extent, the mobility of labour also.

The budget is to be the instrument for effecting the main part of the policy. Public outlay can influence total demand directly, while fiscal policy can redistribute spending power and thereby influence total demand indirectly. The influence is not confined to varying the volume of total demand, but also includes varying the proportions of total demand for consumption and investment goods respectively. It must be remembered that the plan for social security outlined in the official report is one of the more important elements in the fiscal policy.

With regard to frictional unemployment, control over the location of industry by the State will, to some extent, bring the market for labour to the labourer's door, and thus avoid the housing and other social difficulties engendered by labour transference. In so far as occupational mobility of labour is inadequate, the State may have to resort to the "direction" of young persons, on the grounds that they form the most adaptable section of the labour forces, but a rigid policy in this direction which would, after all, infringe an essential liberty, is not envisaged. Reliance is rather placed upon the fuller use of employment exchanges or some alternative institution and on the abolition of unnecessary restrictions upon entry into trades.

To support his policy, the author constantly appeals to the fact that war, by socializing demand, solves the unemployment problem. This argument is not altogether convincing. War is in the nature of a crisis in which we try to exploit our labour, capital resources and credit exhaustively, but not, it is thought, altogether successfully. Many square pegs have been directed into round holes, while "They also serve who only stand and wait" has some relevance for quite a number of citizens compelled to serve in the forces, war-time administration and industry, and the author himself admits that this sort of idleness is just as demoralizing as unemployment itself. No doubt under compulsion and the stress of war individuals will tolerate unsuitable and unsatisfactory employment for what amounts to a relatively short period. Collectively they will not; war has not prevented strikes from occurring. Moreover it remains to be shown that society can organize as efficiently for constructive ends as for the powerful passion-raising destructive ends. The plan for a "New Deal" for Britain would have lost none of its force if the constant references to war-time conditions had been omitted altogether.

The success of the plan obviously depends upon the efficiency of the Government departments concerned. Without prompt and suitable action in the manipulation of total demand, the policy, if undertaken fully, may even create social evils. Faced with a situation bordering upon a chronic labour shortage, employers may develop new restrictive and reactionary practices to ensure for themselves an adequate pool of labour, perhaps in the guise of priorities. Workers may occasionally forget the social ideal before them under the more pressing interest of immediate considerations. These are the more obvious points of difference which are likely to distinguish theory from practice, and no doubt the reader will wonder whether the plan means exchanging the old evils of the labour market for some new ones.

In an appendix, the quantitative aspect of full employment is outlined by Mr. Nicholas Kaldor. Anticipating some criticism, Sir William Beveridge quite rightly states that the policy outlined in the main portion of the book does not stand or fall by the estimates used in this appendix. Nevertheless, the statistical background is interesting. In order to ascertain the distribution of incomes under full employment, coefficients of correlation between wages, salaries and national income were established over the fifteen years prior to the outbreak of war. A coefficient of correlation was also established between national income and imports. Correlation of time series over relatively short periods is a speculative sort of exercise which is always likely to offend the susceptibilities of the statistician, but in rough calculations of this type most readers will probably be prepared to accept the results as a first approximation to the truth. The appendix is no more than an arithmetical illustration of the text, and should be accepted as such.

T. M. R.

5.—*Foreign Exchange*. By F. J. Docker. London: P. S. King. 1939. 8½" × 5½". xii + 326 pp. 15s.

Economics is a complicated subject. It is complicated for two reasons: first, there is the usual difficulty in linking up economic phenomena with what might briefly be called "the counting of one's variables and independent equations"; and, secondly, because economic changes are usually due to many factors. Deductive economics is complicated because there is so much one has to forget, while in inductive economics there is so much to remember.

Foreign exchange is just as involved as the other subjects of economic science, for both the reasons stated above. Mr. Docker simplified his problem by concentrating on the *description* of the whole mechanism. Indeed, it would perhaps be too much to call this work "inductive economics"; it is more a collection of *facts* and their statistical illustration.

This course is necessarily much simpler: you state the sort of difficulty a government might come up against, describe the various measures taken in different countries, and bring statistical evidence to prove the expected results. There is, in this book, a considerable amount of information referring to the monetary history of the last twenty years for practically every country and, as there are no hypothetical cases under discussion, it is always possible to find a few countries where monetary statistics broadly illustrate the point. The great variety of drastic measures taken and the resultant violent reactions in the international monetary field, together with a flood of published data, make statistical evidence-bearing exceptionally easy.

The book is well written and provides interesting reading, especially for the beginner. It contains a good summary of the Russian banking system, and the hordes of innumerable Reichsmark-abortions are also faithfully described. It deals with barter and clearing agreements, protection policies and capital movements. It also discusses the Exchange Equalization Funds and the Bank of International Settlements. There is a peculiar "elementariness" throughout the book, a continuous working out of simple examples, which—however wearisome—one must admit, has an exceptional didactic value.

One could have recommended this book as a good introduction to a difficult subject, had the author not broken his pledge to "leave theories to others." Indeed, to omit his two theoretical chapters ("Exchange Rates and the Purchasing Power of Money" and "The Effectiveness of the Gold Standard") would leave the value of the descriptive remainder unaffected, if not enhanced. The author dismisses the "Purchasing Power Parity" theory on the ground that under the gold standard currency values were fixed in terms of gold, and under the regime of free exchanges, statistical evidence does not support the claims of the theory. It is obvious that when relative exchange rates are *fixed*, the rates could not possibly *alter* in accordance with the price levels, but the author does not see that it could be the other way round. Again, the examination of relative movements of gold prices in some three dozen countries during the unique cycle of 1931–36 could hardly be considered relevant to the validity of a theory of long period equilibrium.

The author also maintains that the gold standard fails to keep relative price levels stable, for an adverse balance of trade due to relative price changes will not always be compensated by an export of gold; there might be an offsetting import of capital, for instance. Now, this is clearly false. If the change in prices is of a fairly permanent character, there will be a *recurrent* adverse balance of trade. To counteract that a continuous flow of capital will be necessary. This will bring the relative rates of interest into the picture (these are entirely missing from Mr. Docker's description of the "rules of the game"), the flow of capital will sooner or later dry up, and we are tending back towards equilibrium.

In the light of present day problems this book is a sad reminder of the remarkable gap which exists to-day in the field of international economics. On the descriptive side, there is need for an adequate presentation of the all round international consequences of monetary measures as opposed to the purely

national aspects of repercussions abroad. But it is mainly in the field of theory where the end of the war will have caught economists napping. This is all the more conspicuous when the recent achievements in the economics of national income and welfare are borne in mind. It is to be sincerely hoped that more serious thought will soon be given to these problems in order to bring the international theory of money and employment up to date. At the present stage, there is no theory which could provide constructive guidance for the statesmen groping with the complicated tasks of international stabilisation.

G. A. B.

6.—*Comparative Operating Experience of Consumer Instalment Financing Agencies and Commercial Banks, 1929-41*. By Ernst A. Dauer. New York: National Bureau of Economic Research. 1944. 9½" x 6". xviii + 221 pp. 3 dollars.

This book is the tenth in a series of studies in consumer instalment financing prepared under the Financial Research Programme of the National Bureau of Economic Research. It represents a comparative study of the financial structure and operating characteristics of the various American institutions directly or indirectly providing the consumer with credit on the basis of repayment by instalments, and, containing some fifty tabulations, appears to be very fortunate in the adequacy of its statistical background.

The comparison is primarily between the commercial bank and the more specialized type of institution, such as the personal finance company, the sales finance company and the industrial bank. The entry of established commercial banks into the business of financing consumers on an instalment basis is only one of the several indications of the great change in attitude by the financial world towards this class of business in the period between the wars. The experience of the specialized institutions showed that it was a profitable business, while in the 1930's the earnings from orthodox banking sank to very low levels. These facts doubtless helped to sweep away the barriers to the granting of "non-productive" loans by commercial banking concerns.

The granting and collecting of small loans involves relatively high operating costs, and where usury laws place a low ceiling upon the maximum rate of interest, it is difficult and perhaps impossible to undertake this work profitably. Many of the State legislatures, however, have recognized the legitimacy of small loan business, and the specialized agencies were accordingly exempted from this restriction, or were permitted to develop technical devices for circumventing it. Once legitimate business proved itself by becoming soundly established, the agencies were gradually able to work their way into the money market and obtain part of their resources there, just as the commercial banks were finding it safe and profitable to enter the field of consumer instalment finance. The business of providing the consumer with credit for the purchase of durable goods had at last become "respectable." Specialization became less absolute, most of the commercial banks holding small quantities of retail instalment credit and cash instalment loans to consumers among their assets, and some of the agencies carrying commercial loans and securities among theirs whenever competition had drained the market of the normal outlet for their surplus funds.

After comparing and contrasting the main features of the various specialized agencies, Dr. Dauer extends his investigations to the individual companies falling into each class, in order to bring out possible significant differences due to size and locational factors. It is shown that size, beyond a certain negligible limit, brings no economies in operating costs, while location, in itself, has no important bearing. Both factors are important, however, in that they are usually related to the type of business transacted. A large company will often carry a higher proportion of big loans than a smaller one, and it is the large loans which earn the lower rates of interest. A company in an industrial region will usually find a greater degree of elasticity in its resources and assets than one serving a rural community.

Although ancillary to the main purpose of the study, the reviewer found

himself more interested in the historical aspect of American consumer instalment finance implicit in the book rather than in the exhaustive comparative analysis of the balance-sheet items and the main categories in the profit and loss accounts of the various institutions. As illustrated in the previous paragraph, the principal conclusions reached contain no surprising element, and it is suggested that anyone interested in the subject from a general point of view might consult one of the studies earlier in the series with more profit. This is not intended to be a reflection on the merits of this particular study, which, as a matter of fact, deals with its own aspect in a thoroughly competent and readable way, and will without doubt be of great interest to the specialist.

T. M. R.

7.—*Future Education and Training for British Industry.* By Tudor J. Jones. London: Harrap. 1943. 8½" × 5½". 95 pp. 5s.

The review of this little book has been unavoidably delayed, but as interest in all phases of post-war planning was never more lively than at the present moment, the subject treated has gained rather than lost in topicality.

Mr. Tudor Jones envisages a new order of things, internationally, nationally, and particularly in the field of industry, and suggests a comprehensive scheme of education and training which will not only fit in with the new order as an important component part, but will be necessary to the realization of it.

Perhaps too much attention has been paid in the past to the development of our material resources, at the expense of the development of our human resources, yet surely the latter have the greater potentialities. The author is to be congratulated on his courageous attempt to grapple with the problem of preparing the young for a fuller life as individuals, as workers and as citizens.

T. M. R.

8.—*The Journey Home.* A Report prepared by Mass Observation for the Advertising Service Guild. Published for the Advertising Service Guild by John Murray. London. 1944. 8½" × 5½". 123 pp. 6s.

It would appear that none of the surveys of Mass Observation have previously been commented on in the *Journal*. Yet the measurement of public opinion and the elucidation of what people are thinking are certainly of interest to the statistician, and as Mass Observation claim that they have discovered a new method of investigating these phenomena, their claim must be examined.

In this country those who claim to measure public opinion may be divided into two groups. There are, in the first place, those who have adopted the methods of the Gallup poll, in which a sample of the population is asked a specific question to which a positive or negative answer must be given. The proportion of people answering in the affirmative is regarded as a good approximation of the true proportion within the population. Although in practice the Gallup poll method leaves much to be desired, it is in our opinion greatly superior to the methods used by Mass Observation.

The main objection that is levelled against the supporters of the Gallup method by Mass Observers is that as a matter of experience incorrect and unreliable answers tend to be given when a person is interviewed by a stranger, and that public opinion can be truly gauged only by a careful scrutiny of the opinions expressed by people in conversation. Mass Observation accordingly employ a panel of voluntary observers whose task it is to record such conversations, and they also utilize the services of diarists, who submit their diaries for the organization's scrutiny. As will appear, however, they do make quantitative statements on the basis of sample surveys. These samples appear to be selected in a reckless fashion.

It follows that Mass Observation's reports are a curious mixture of anecdotes, figures and general conclusions. As readers of this notice will be primarily interested in the statistical aspect of this survey, it may be pointed out that "the main statistics are based on 570 interviews, half in London, half in other parts of the country." "Where total figures are given they are weighted so as not to give undue prominence to London" (p. 8). We are told that 53 per cent. of the

sample were men, that 43 per cent. were less than 40 years of age, that 19 per cent. belong to the middle and 39 to the artisan class. How the middle or artisan class is constituted is left undefined. It would seem that a sample of 570 cases seems a disproportionately small portion of the population on which to base statements like the following:

"Sixty-nine per cent. are expecting demobilization to take longer than one year, amongst those expecting the war to last for over one year [an unspecified number] the percentage rose to 73 per cent."

"Thirty-seven per cent. of non-war workers expect *much* unemployment after the war" (my italics).

As is evident, it is frequently impossible to find out on how many cases a particular percentage is based, and the exact meaning of the terms used remains undefined. Different people may have different views as to what constitutes "much" unemployment.

But perhaps it is unfair to stress the quantitative point of view overmuch. On p. 9 the authors wish "to stress the qualitative aspects of this Report." There is no doubt that they sincerely believe that they are accurately interpreting public opinion, but one is sometimes led to believe that they do not fully realize the complexity of their task. It must be extremely difficult to sift all the information that has been collected in Mass Observation's files and to be certain that nothing relevant has been left out. Moreover, each of their reports is made by different observers, and however objective these observers may try to be, their ideas of what is important or relevant in conversation are bound to differ. It is difficult to be certain that all cross-currents of opinion are adequately represented. As one is primarily interested in public opinion as a guide to popular reactions to certain policies, it is at least arguable that the sort of conversations that are reported in this book may be an unreliable indication of probable reactions. A clear-cut question, as put by the Gallup poll, might give as good or a better result. It is difficult to be certain of this, but in the absence of any positive information, one belief is as good as another.

Even if we concentrate our attention on the qualitative aspects of the report, the results are by no means impressive. The main conclusion is that many people expect demobilization to last a long time, and that the majority of service-men are hoping, quite irrationally, that, in spite of this, they will somehow manage to get out quickly. It might perhaps be suggested that it was hardly necessary to utilize the whole machinery of mass observers and diarists to obtain these conclusions; any reasonably observant person who comes into contact with other people would be able to say very much the same thing.

When we come to a discussion of the attitude of certain sections of the population, such as Civil Defence workers or service-women, the conclusions do not convince. Mass Observation may be right or wrong in their estimate of opinion amongst these sections, but their method does not inspire sufficient confidence to warrant accepting their results without a very great deal of additional research.

E. G.

STATISTICAL NOTES

1. BRITISH OFFICIAL STATISTICS

By the end of 1944 the level of general wholesale prices, as measured by the Board of Trade index-number, had risen since the beginning of the war by about 70.5 per cent. Food and tobacco prices had risen 73.2 per cent. and those of industrial materials and manufactures 68.9 per cent. Of the eleven groups into which the two hundred items comprised in the index-number are divided, those showing the greatest advances in price were of cereals (98.4 per cent.), cotton (97.3 per cent.), coal (90.8 per cent.), wool (79.7 per cent.) and textiles other than cotton and wool (83.7 per cent.). The smallest advance was that of the non-ferrous metal group (27.2 per cent.) but prices of these metals and their supply to a very large extent have been controlled throughout the period of the war. The major portions of these advances took place during the first seventeen months of the war and more than 80 per cent. of the total advance had occurred by the end of 1941, by which time food prices had risen 66.5 per cent., prices of materials and manufactures 55 per cent. and general wholesale prices 58.9 per cent. Advances during 1942, 1943 and 1944 were on a small scale and general prices advanced only 3.4 per cent., 1.3 per cent. and 2.3 per cent., respectively, the index-number for food and tobacco showing an actual decline in the last two years of about 1½ per cent.

(Averages for the Year 1930 = 100)

Date	Total Food	Total not Food	All Articles	Basic Materials	Intermediate Products	Manufactured Articles	Building Materials
Sept. 1944	156.8	172.2	167.1	186.0	176.2	159.9	154.2
Oct. "	155.9	172.1	166.7	185.9	176.2	159.9	153.9
Nov. "	155.9	172.5	166.9	186.8	176.2	160.2	153.9
Dec. "	156.6	172.6	167.2	187.2	176.2	160.2	153.9
Dec. 1943	158.3	165.7	163.1	177.6	172.5	156.5	150.6
Aug. 1939	90.4	102.2	98.1	91.5	101.0	108.7	101.1
Percentage increase in Dec. 1944 over—							
Dec. 1943	1.1*	4.1	2.3	5.4	2.1	2.4	2.2
Aug. 1939	73.2	68.9	70.5	98.2†	69.2	47.4	47.8

* Decrease.

† See footnote on p. 69 of Part I of *Journal* for 1944.

As regards 1944 there was an increase in the index-number for industrial materials and manufactures of 4.1 per cent. due principally to advances in the group indexes for coal (20.6 per cent.) and cotton (17.2 per cent.). Prices of raw cotton were advanced 4½d. per lb. in April and yarn prices were also increased, but prices of "utility" cloths were kept steady by means of a system of rebates. Prices of some classes of manufactured iron were advanced in August, and prices of tin were raised 9 per cent. from the beginning of the year. There were

also appreciable increases in the prices of certain classes of hides and skins (18-20 per cent.) and in the prices of tiles (19 per cent.).

Food prices declined 1.1 per cent. owing chiefly to reductions in the prices of barley offset to some extent by increases in the prices of wheat and flour. The index-number for meat, fish and eggs remained stationary throughout the year.

The table on p. 302 shows the course of the Board of Trade index-number from September 1944 with the percentage increases in December 1944 over the figures for December 1943 and August 1939.

It should be borne in mind that "in cases where, since the outbreak of war, the Government has bought a commodity at one price and resold it at a lower one (e.g., home-produced meat), the subsidized price is the one used for the index; where different prices are charged according to the use to which the article is put (e.g., in the case of sugar and flour), a weighted average of these is taken."

The figures for certain other British index-numbers of wholesale prices and those of the United States Bureau of Labour are set out below.

Date	Board of Trade (1930 = 100)	Economist (1937 = 100)	Statist (1866-77 = 100)	The Times (1913 = 100)	United States Bureau of Labor (1926 = 100)*
Sept. 1944	167.1	117.9	160.1	184.4	103.6
Oct. "	166.7	117.9	159.6	184.3	103.9
Nov. "	166.9	117.9	160.3	184.3	104.1
Dec. "	167.2	118.3	160.7	185.1	104.4
Dec. 1943	163.4	113.7	153.9	177.6	102.9
Aug. 1939	98.1	70.3	90.4	114.5	74.8
Percentage increase in Dec. 1944 over—					
Dec. 1943	2.3	4.0	4.4	4.2	1.5
Aug. 1939	70.5	68.3	77.8	61.7	39.6

Mean of weekly prices.

There was an increase of about 1½ per cent. in the general *cost of living* of working-class families in 1944 as measured by the index-number prepared by the Ministry of Labour and National Service. This increase was almost entirely due to the advances in the retail prices of coal of 3s. per ton at February 1st and 4s. per ton at August 1st. There was also some increases in the prices of men's overcoats and suits which took place gradually during the year. Prices of potatoes advanced in the third quarter of the year, but fell again by October. The net effect of these changes was to advance the general index-number from 199 at January 1st, 1944, to 202 at January 1st, 1945 (Prices at July 1914 = 100). The following table shows the index-number at various recent dates.

Date	Food	Rent and Rates	Clothing	Fuel and Light	Other Items	All Items
Oct. 1st, 1944	168	164	345	263	291	201
Nov. 1st "	168	164	345	263	291	201
Dec. 1st "	168	164	345-350	264	291	201
Jan. 1st, 1945	168	164	345-350	265	291	202
<i>Jan. 1st, 1944</i>	<i>168</i>	<i>161</i>	<i>310-345</i>	<i>241</i>	<i>291</i>	<i>199</i>
<i>Sept. 1st, 1939</i>	<i>138</i>	<i>162</i>	<i>205-210</i>	<i>180-185</i>	<i>180</i>	<i>155</i>
Percentage increase at Jan. 1st, 1945 over—						
Jan. 1st, 1944	—	—	1	9	—	1.5
Sept. 1st, 1939	22	1	67	46	63	30

As has been stated before "no allowance has been made for any economies or readjustments in consumption and expenditure since the outbreak of war" and rationing has no doubt entailed increased expenditure on articles not included in the index-number, especially in the case of articles of food.

The annual *index-number of agricultural prices* calculated by the Ministry of Agriculture for 1944 shows an increase of $6\frac{1}{2}$ points over the previous year, the figure being 170, as compared with 163 $\frac{1}{2}$ in 1943 and 161 $\frac{1}{2}$ in 1942. In the three years 1937-39, the general index-number was practically stationary at 90 $\frac{1}{2}$, so that the increase in the war period from that figure to 170 in 1944 represents a rise of nearly 88 per cent.

The changes in the last five years are shown below, the recent figures being provisional. Allowance is made for Government subsidies, including both Exchequer payments and payments in respect of the acreage under wheat and potatoes based on the estimated quantities entering into sale. These two latter payments were equivalent in 1944 to 4s. per cwt. in the case of wheat and 40s. per ton in the case of potatoes.

(Base 1927-39 = 100)

	1940	1941	1942	1943	1944
Cereals and farm crops	124 $\frac{1}{2}$	155	187 $\frac{1}{2}$	181	182 $\frac{1}{2}$
Livestock and livestock products	121 $\frac{1}{2}$	137	150	151 $\frac{1}{2}$	158 $\frac{1}{2}$
Fruit, vegetables and glass-house produce	145 $\frac{1}{2}$	228	186	203 $\frac{1}{2}$	205
General index	125	150 $\frac{1}{2}$	161 $\frac{1}{2}$	163 $\frac{1}{2}$	170

The level of prices in the cereals and farm crops group has been kept consistently higher than in the livestock group owing to the necessity for stimulating the production of wheat and of feeding-stuffs for livestock as a means of saving shipping space. Milk, the principal commodity in the livestock group, has, however, been steadily supported and the index-number in 1944 was 187 as compared with 178 in the previous year. This was appreciably higher than any other item in the group except cheese.

Comparison with the index-numbers of prices ruling during the last war shows that the level in the four years 1914-17 was definitely lower than in the

four years 1939-42, a position to be expected from the fact that the pressure on production was much less in the earlier part of the last war. Subsequently the index-number rose appreciably and was 160 in 1918 and 178 in 1919, figures which may be compared with 163½ in 1943 and 170 in 1944. Thus in the sixth year of the present war the average level of prices was somewhat below that for the corresponding period of the 1914 war.

The number of workpeople on the *unemployment* registers of the Ministry of Labour and National Service showed some increase (17,873) at October 16th, 1944, as compared with the previous date and a further increase (17,650) at January 15th, 1945. The number on the registers at January is still less than a hundred thousand, and is to a considerable extent seasonal, although a portion of the increase may be due to small discharges from factories on less urgent work and to the registration of "school-leavers." A large proportion of those on the registers is, no doubt, of those in the process of changing jobs. The total number (98,720) cannot be sufficient to meet the usual demands of industry under normal conditions. In addition to the total, 20,451 men had been classified by interviewing panels as unsuitable for ordinary industrial employment, and 353 women as unsuitable for normal full-time employment. Of the total number 73,193 were applicants at January 15th, 1945, for unemployment benefit or allowances.

The numbers on the registers of the Ministry at quarterly intervals are set out below for the undermentioned dates.

Date	Wholly Un- employed	Temp- orarily Stopped	Persons normally in Casual Em- ployment	Total	Males	Females
April 17th, 1944 ...	73,092	653	945	74,690	51,471	23,219
July 17th, " ...	61,905	599	693	63,197	45,032	18,165
Oct. 16th, " ...	79,235	1,029	806	81,070	56,513	24,557
Jan. 15th, 1945 ...	95,273	2,595	852	98,720	65,073	33,647
Jan. 17th, 1944 ...	76,674	1,417	946	79,037	51,294	27,743
Aug. 14th, 1939 ...	968,108	211,978	51,606	1,231,692	947,099	284,593

The number of *trade disputes* in the United Kingdom in 1944 involving stoppages of work was 2,185 compared with 1,785 in 1943. The number of workpeople affected was 820,000, of whom 105,000 were indirectly involved—*i.e.*, thrown out of work at the establishments where the disputes occurred, but not directly parties to the disputes. The aggregate number of working days lost was about 3,700,000, of which about two-thirds were accounted for by disputes in the coal-mining industry and one-quarter by those in the metal, engineering and shipbuilding trades. The number of days lost was greater in 1944 than in any year since 1932. Most of the days lost in the coal-mining industry were owing to dissatisfaction with the award of the National Reference Tribunal for the industry in January, which provided for increases in the minimum weekly wages for underground and surface workers. The award fixed the

minimum weekly wages for adult underground workers at 100s. and for surface workers 90s., with substantially proportionate rates for juvenile workers.

There was an aggregate net increase in 1944 of about £1,870,000 in the weekly full-time *rates of wages* of 8,100,000 workpeople compared with a similar net increase of £1,400,000 in the rates of 6½ million workpeople in 1943. These figures exclude changes in the wages of agricultural workers, Government employees, domestic servants, shop assistants and clerks. It is estimated by the Ministry of Labour that at the end of 1944 the average level of full-time weekly rates of wages in all industries (including agriculture) for which information is available was about 5 per cent. higher than at the end of 1943 and about 45 or 46 per cent. higher than at the beginning of the war. It should be pointed out that actual weekly earnings are considerably in excess of these figures. The Ministry's census of earnings at half-yearly intervals shows that at January 1944 weekly earnings had increased since October 1938 by 79 per cent. for all classes of workpeople combined (male and female skilled and unskilled).

2. OTHER STATISTICS

The statistics of *retail sales* prepared by the Bank of England show that for the trade year February 1944 to January 1945, the total value of sales (at selling value) exceeded that in the previous twelve months by 6.9 per cent. Sales of food and perishables increased 5.4 per cent., and those of non-food merchandise by 9.1 per cent. The greatest increases were in men's and boys' wear (27.8 per cent.), women's wear (16.3 per cent.) and dress-materials (14.4 per cent.). There was a decline of 1.7 per cent. in the value of sales of household goods (piece materials), and of 4.7 per cent. in the sales in furnishing departments. There was an increase of from 7.6-8.8 per cent. in the sales in all districts except in Central and West End London where there was a decrease of 1.1 per cent., and in Suburban London where the increase was only 2.4 per cent.

The index-number showing the average daily sales has been re-calculated on the basis of the figures for 1942 and the following table gives for the years 1941-44 the index-numbers representing the sales of the different classes of merchandise.

(Average Daily Sales in 1942 = 100)

Year (Jan.-Dec.)	Piece Goods (House- hold)	Women's Wear	Men's and Boys' Wear	Boots and Shoes	Furnishing Depart- ments	Hardware	Food and Perish- ables	All Depart- ments *
1941	97	97	101	93	94	112	97	98
1942	100	100	100	100	100	100	100	100
1943	87	89	80	89	87	94	102	98
1944	97	104	102	93	82	94	107	105

Including fancy departments, sports and travel, miscellaneous and unspecified.

The Interim Commission of the Conference held at Hot Springs in May 1943 has now presented for acceptance by the Governments concerned the Constitu-

tion of the *Food and Agriculture Organization of the United Nations*.^{*} It is proposed that the Constitution should come into force as soon as it has been accepted by twenty Governments, and that at an early date thereafter a Conference should be held to proceed with the establishment of the Organization. The Constitution has now been formally accepted by the British Government. The temporary seat of the Organization is to be at Washington, and the provisional budget for the first financial year has been fixed at 2,500,000 dollars of which the United States will contribute 25 per cent. and the United Kingdom 15 per cent. The Interim Commission recommends that the average expenditure during the first five years should be estimated at about 5,000,000 dollars per annum.

The above document is accompanied by a very interesting Report by the Interim Commission setting out in more detail its views on the functions of the Organization, and the lines on which it should operate in order to carry out the proposals of the Hot Springs Conference. An enormous field is covered involving practically all aspects of nutrition, food and agriculture, including fisheries, forestry, and non-food agricultural products such as cotton, wool, jute, oils and fats, hides and skins, and tobacco.

Prominence is given to the importance of statistics and the following may be quoted: "The regular collection and systematic presentation of relevant statistics obtained from Member nations and international authorities will be fundamental; and continuity in the statistical series collected will be important to ensure accurate interpretation of current and future trends. The Organization should receive regularly all published statistical material, and should also have access to unpublished material relevant to its work. The basic statistical data in many countries are very imperfect. The Organization should devise effective methods for obtaining more accurate statistical information at minimum expense, and should also make the services of its technical staff available to any Government needing assistance in organizing or improving national statistical services. New methods of sampling, for example, which have recently been developed, are known and used in few countries." It is also suggested that the Organization should undertake a world agricultural census in co-operation with the Governments concerned, and "it will clearly be essential to publish an authoritative and comprehensive year-book of international statistics."

The Interim Commission intends to submit separately recommendations regarding the International Institute of Agriculture, which has in the past done a good deal of work in the field of agricultural statistics.

Another point in the Commission's Report which may be mentioned relates to "international commodity arrangements," such as, for example, the various Wheat Agreements made in pre-war years. The Commission recommends that international commodity arrangements for both agricultural and non-agricultural products should be co-ordinated under the supervision and direction of a single international authority and that a Conference should be convened to formulate the principles governing such arrangements.

^{*} Documents relating to the Food and Agriculture Organization of the United Nations, August 1st-December 14th, 1944. Cmd. 6590. Price 9d. A note on the United Nations Conference appeared in the *Journal*, Part III, 1943.

CURRENT NOTES

The Council has decided to form two new sections, the Research Section and the Industrial Applications Section, in substitution for the former Industrial and Agricultural Research Section, which suspended activities at the outbreak of war.

The Research Section is "concerned with research into the theory of statistics and statistical methods and with the development of their applications." The Industrial Applications Section is "concerned with the application of statistical technique to industrial research, development and manufacture, including inspection."

Membership of a Section is open to Fellows free of charge. Fellows who are interested are asked to send in their names to the Assistant Secretary, specifying which Section they wish to join. Fellows who do not enrol in this way will not receive notices of Section Meetings.

Membership of a Section is also open to non-Fellows who are approved by the respective Section Committees, on payment of ten shillings per annum per Section. Applications for membership should be sent to the Assistant Secretary. Fellows are asked to bring these facilities to the notice of any non-Fellows who may be interested.

A more extended account of the constitution of the Sections and the programmes of meetings for the coming session will be given in Part 1 of the *Journal* for 1945.

We have been asked to make the following announcement:—

Applications are invited for two Official Fellowships of Nuffield College, Oxford. The persons elected will be required to devote themselves to research in the field of Economics and Politics. Appointments will be made in the first instance for three years but will be renewable: stipend, which will be not less than £600 or more than £1,200 a year, will be according to age and experience, and will carry with it membership of the Federated Superannuation Scheme for Universities.

Appointments will not necessarily be restricted to applicants with academic qualifications, but will be open to anyone whose special experience enables him to make a special contribution to the College's work. The choice of the College will not necessarily be confined to those who apply, and the College does not bind itself to make any election if in its opinion no suitable candidate presents himself. Candidates who are not able to take up their duties immediately owing to war service will be given full consideration.

Applications should be addressed to the Warden of Nuffield College, 17 Banbury Road, Oxford, not later than September 1st, 1945; they should be accompanied by a statement of the applicant's experience and scientific interests, and by such testimonials (not more than three in number) and names of persons to whom reference may be made as the candidate desires to submit.

STATISTICAL AND ECONOMIC ARTICLES IN RECENT PERIODICALS

UNITED KINGDOM—

Agriculture—

November 1944—Five years of war-time farming.

Biometrika—

August 1944—Comparison of the concepts of efficiency and closeness for consistent estimates of a parameter: *R. C. Geary*. The relations between measures of correlation in the universe of sample permutations: *H. E. Daniels*. The control of industrial processes subject to trends in quality: *L. H. C. Tippett*. Studentization, or the elimination of the standard deviation of the parent population from the random sample-distribution of statistics: *H. O. Hartley*.

Economic Journal—

December 1944—Price and output policy of state enterprise: *J. E. Meade* and *J. M. Fleming*. The future of interest rates: *E. V. Morgan*. Professor Pigou on the relative movements of real wages and employment: *S. C. Tsiang*. Some relationships of landlord and tenant: *J. Muriel Ritchie*. Notes on the relationship between economists and accountants: *H. Norris*. Livelihood and full employment: *R. G. Hawtrey*.

Oxford Institute of Statistics, Bulletin—

Vol. 6, Nos. 16 & 17—Employment in the United Kingdom during and after the transition period: *M. Kalecki*. Family diets at low cost, *November 1944*: *T. Schulz*. The T.U.C. and reconstruction: *G. D. N. Worswick*. Post-war employment in Australia: *J. Steindl*.

Public Administration—

Winter Number 1944-45—The public corporation: *Sir Henry Bunbury, K.C.B.* The New Zealand means test: *Professor Leslie Lipson*.

Review of Economic Studies—

Summer 1944—A note on the economics of retaliation: *T. Balogh*. Rents, rates and incomes in Bristol: *A. W. T. Ellis*. Rent subsidies on a national basis: *M. J. Elsas*. A note on an index number problem: *E. Rothbarth*. Patent reform: *Michael Polanyi*.

INDIA—

Indian Journal of Economics—

October 1944—The future of gold vis-à-vis currency plans (II): *Lalwani Kasturchand*. The place of agriculture vis-à-vis industry in the Industrialists' Plan: *A. N. Agarwala*. Taxation of monopoly: *J. K. Mehta*.

AUSTRALIA AND NEW ZEALAND—

Economic Record—

December 1944—Some aspects of full employment: *J. M. Garland*. The uniform income tax plan (1942): *K. H. Bailey*. The Australian war economy, May–October 1944: *H. Burton*.

UNION OF SOUTH AFRICA—

South African Journal of Economics—

December 1944—Panaceas, past and present: The history of some current ways of thought and plans for economic reform: *H. M. Robertson*. The distribution of benefits in the social security proposals: *Edward Batson*.

UNITED STATES—

American Economic Review—

December 1944—A practical international monetary policy: *E. M. Bernstein*. The International Bank for reconstruction and development: *Arthur Smithies*. The "Burden of the Debt" and the national income: *E. D. Domar*. Income, money and prices in wartime: *J. L. Mosak* and *W. A. Salant*.

American Philosophical Society—

November 1944—Postnatal development of the human extremities: *C. B. Davenport*.

American Statistical Association, Journal—

December 1944—Wartime developments in agricultural statistics: *H. R. Tolley* and *Conrad Taeuber*. Insurance in the international balances of payments: *S. J. Lengyel*. Measurement of industrial production since 1939: *Frank R. Garfield*. Economic consumption scales and their uses: *Robert Morse Woodbury*. The distribution of private, non-agricultural employees in the United States by straight-time hourly wage rates: *David R. Roberts*. A simplified calculation of the potency of penicillin and other drugs assayed biologically with a graded response: *C. I. Bliss*. A method of analysis of family composition and income: *T. J. Woodter, Jr.* Determining sample size: *J. A. Nordin*.

Annals of Mathematical Statistics—

December 1944—Some extensions of the Wishart distribution: *T. W. Anderson*. Statistical tests based on permutations of the observations: *A. Wald* and *J. Wolfowitz*. Error control in matrix calculation: *F. E. Satterthwaite*. Inverse tables of probabilities of errors of the second kind: *Emma Lehmer*. Some combinatorial formulas with applications to probable values of a polynomial-product and to differences of zero: *L. H. Hsu*. Ranges and midranges: *E. J. Gumbel*.

Econometrica—

July-October 1944—Random simultaneous equations and the theory of production: *J. Marschak* and *W. H. Andrews*. Stock market forecasting: *Alfred Cowles*. The rationalization of succession taxation: *William Vickrey*. The new economics of spending: a theoretical analysis: *Hans Neisser*. The relation between Hicksian stability and true dynamic stability: *Paul A. Samuelson*.

Harvard Business Review—

Autumn Number, 1944—Physically handicapped workers: I. Experience in war industries. II. Rehabilitation of veterans: *Ross A. McFarland*. Electric power in industry and agriculture: *C. O. Ruggles*.

Journal of Experimental Education—

December 1944—Evaluation of a prolonged pre-academic program for high grade mentally deficient children in terms of subsequent progress: *R. Melcher Patterson*. The relative intellectual achievement of mentally gifted and retarded children: *W. Drayton Lewis*.

Journal of Political Economy—

December 1944—Realism and relevance in the theory of demand: *Frank H. Knight*. Strike profiles: *John V. Spielmans*. On debt policy: *Henry C. Simons*.

Milbank Memorial Fund Quarterly—

October 1944—Findings of the study of chronic disease in the Eastern Health District of Baltimore: *Jean Downes*. Findings of selective service examinations: *George St. J. Perrott*. Recent findings on nutritional status of industrial workers: *Dorothy G. Wiehl*. The demographic position of Egypt: *Clyde V. Kiser*. Problems of policy in relation to areas of heavy population pressure: *Frank W. Notestein*.

UNITED STATES—Contd.

Quarterly Journal of Economics—

November 1944—War and inflation in Spain, 1780–1800: *Earl J. Hamilton*. Income-generating effects of a balanced budget: *Henry C. Wallich*. Strikes and lock-outs in Great Britain: *Eugene L. Gomborg*. Pareto on population, II: *J. J. Spengler*.

Record—

June 1944—Valuation of disability claims: *Herbert L. Feay*. Some actuarial aspects of social insurance: *Manuel Gelles*.

November 1944—The selection of tuberculosis: *Annie Mary Lyle*. Ratings for tuberculosis: *Pearce Shepherd*. The American family: *Mortimer Spiegelman*. Notes on the technique of planning: *Edward H. Wells* and *H. Knauss*.

Review of Economic Statistics—

November 1944—A symposium on the International Monetary Fund and International Bank for reconstruction and development proposed at Bretton Woods: *Condliffe, Halm, Harris, Haberler, Hansen, and Lachman*. Government net contributions and foreign balance as offset to savings: *Hans Neisser*. A note on the mathematical coincidence of the instantaneous and the serial multiplier: *Karl Bode*.

Social Research—

November 1944—The economics of a stationary population: *Hans Neisser*.

Wheat Studies of the Food Research Institute—

July 1944—Interregional correlations in wheat yields and outputs: *V. P. Timoshenko*.

EGYPT—

L'Egypte Contemporaine—

Mars-Avril 1944—L'Egypte devant les plans monétaires internationaux: *E. Minost*. Le problème du blé en Syrie et au Liban pendant la guerre: *Jean Godard*.

MEXICO—

Estadística—

December 1944—A new sample of the population: *Morris H. Hansen* and *W. N. Hurwitz*.

SWEDEN—

Ekonomisk Tidskrift—

September 1944—Kristidssparandet, inflationsfaran och statsskulden: *Harald Dickson*.

December 1944—Samhällsvetenskapernas utbyggnad vid Universiteten och de Fria Högskolorna: *Gunnar Myrdal*. Marginalskatterna på fysiska personer: *Gunnar Lindgren*.

INTERNATIONAL—

International Labour Review—

December 1944—Co-operative organisations and the post-war housing problem.

LIST OF ADDITIONS TO THE LIBRARY

Since the issue of Part I, 1944, the Society has received the publications enumerated below:—

I.—OFFICIAL PUBLICATIONS

(a) United Kingdom.

Agriculture and Fisheries, Ministry of.

Ensilage, by H. E. Woodman and Arthur Amos. 6th ed. (Bulletin No. 37.) London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. iv + 60 pp. 1s.

Wireworms and food production: a wireworm survey of England and Wales, 1939-1942. (Report from the Advisory Entomologists' Conference.) (Bulletin No. 128.) London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 62 pp. 1s.

Colonial Office. Report on cocoa control in West Africa, 1939-43, and a statement on future policy. London: H.M.S.O., 1944. Cmd. 6554. $9\frac{1}{2}'' \times 6''$. 16 pp. 3d.

Foreign Office.

Belgium, No. 1 (1944). Monetary agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of Belgium. London, 5th October, 1944. London: H.M.S.O., 1944. Cmd. 6557. $9\frac{1}{2}'' \times 6''$. 5 pp. 1d.

Miscellaneous, No. 4 (1944). Dumbarton Oaks conversations on world organisation, 21st August-7th October, 1944. London: H.M.S.O., 1944. Cmd. 6560. $9\frac{1}{2}'' \times 6''$. 10 pp. 2d.

Miscellaneous, No. 5 (1944). United Nations Relief and Rehabilitation Administration. Resolutions adopted by the Council at its second session, Montreal, 16th September, 1944. London: H.M.S.O., 1944. Cmd. 6566. $9\frac{1}{2}'' \times 6''$. 33 pp. 6d.

Miscellaneous, No. 6 (1944). A commentary on the Dumbarton Oaks proposals for the establishment of a general international organisation. London: H.M.S.O., 1944. Cmd. 6571. $9\frac{1}{2}'' \times 6''$. 11 pp. 2d.

Fuel and Power, Ministry of.

The efficient use of fuel: a text-book on fuels and their efficient utilisation, for the use of students and technical men in industry. . . . London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. viii + 807 pp. 12s. 6d.

Statistical digest, Second quarter, 1944 (in continuation of Statistical digest from 1938: Cmd. 6538). London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 20 pp. 4d.

Health, Ministry of.

Report to the Minister of Health by the Departmental Committee on Valuation for Rates, 1939. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 57 pp. 1s.

Summary report of the Ministry of Health for the year ended 31st March, 1944. London: H.M.S.O., 1944. Cmd. 6562. $9\frac{1}{2}'' \times 6''$. 56 pp. 1s.

Health, Ministry of, and Ministry of Works. Housing manual, 1944. 104 pp. 2s. Technical appendices C to L. 92 pp. 1s. 6d.

Labour and National Service, Ministry of.

Catering Wages Act, 1943. Catering Wages Commission first annual report, 1943-44. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 15 pp. 3d.

Industrial relations handbook. London: H.M.S.O., 1944. $8\frac{1}{2}'' \times 5\frac{1}{2}''$. 260 pp. 3s. 6d.

Re-allocation of man-power between the armed forces and civilian employment during any interim period between the defeat of Germany and the defeat of Japan. London: H.M.S.O., 1944. Cmd. 6548. $9\frac{1}{2}'' \times 6''$. 4 pp. 1d.

Re-allocation of man-power between civilian employments during any interim period between the defeat of Germany and the defeat of Japan. London: H.M.S.O., 1944. Cmd. 6568. $9\frac{1}{2}'' \times 6''$. 10 pp. 2d.

Medical Research Council. Industrial Health Research Board. Report No. 85. The recording of sickness absence in industry (a preliminary report). London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. ii + 17 pp. 4d.

(a) United Kingdom—Contd.

- Parliament.* Statistics relating to the war effort of the United Kingdom. London: H.M.S.O., 1944. Cmd. 6564. $9\frac{1}{2}'' \times 6''$. 64 pp. 1s.
- Production, Ministry of.* Report of the Cotton Textile Mission to the United States of America, March–April 1944. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 78 pp. 1s. 3d.
- Reconstruction, Ministry of.* Social insurance, Part I. Cmd. 6550. 64 pp. 6d. Part II. Workmen's compensation proposals for an industrial injury insurance scheme. Cmd. 6551. 31 pp. 3d. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 2 parts.
- Scotland, Department of Health for.* Summary report . . . for the year ended 30th June 1944. Edinburgh: H.M.S.O., 1944. Cmd. 6545. $9\frac{1}{2}'' \times 6''$. 23 pp. 4d.
- Scottish Home Department.* Scottish coalfields: the report of the Scottish Coalfields Committee. Edinburgh: H.M.S.O., 1944. Cmd. 6575. $9\frac{1}{2}'' \times 6''$. v + 184 pp. 3s.
- Select Committee on National Expenditure.*
Reports: Session 1943–44. 7th. Regional organisation of the Ministry of Production. 9 pp. 2d. 8th. The Chemical controls. 11 pp. 2d. 9th. Departmental organisation for the disposal of surplus government stores. 18 pp. 3d. 10th. The administration and cost of the Home Guard. 6 pp. 1d. 11th. The examination of national expenditure. 22 pp. 4d. 12th. Replies from departments to recommendations in reports. 10 pp. 2d. 13th. The work of the Committee in session 1943–44. 6 pp. 1d. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 7 parts.
- Trade, Board of.*
Accounts relating to the export trade of the United Kingdom for the years 1938, 1942, 1943. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 62 pp. 1s.
Accounts relating to the export trade of the United Kingdom for the years 1939, 1940, and 1941. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 56 pp. 1s.
Fifth Census of Production, 1935. Part IV: Section III. Final report, Mines and quarries. 50 pp. 5s. Part IV: Section IV. Final report on the public utility services and government departments. 124 pp. 7s. 6d. London: H.M.S.O., 1944. $11'' \times 8''$.
Tendencies to monopoly in the cinematograph film industry. Report of a committee appointed by the Cinematograph Films Council. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 41 pp. 9d.
- Treasury.* United Nations Monetary and Financial Conference, Bretton Woods, New Hampshire, U.S.A., July 1 to July 22, 1944. Final Act. London: H.M.S.O., 1944. Cmd. 6546. $9\frac{1}{2}'' \times 6''$. 70 pp. 1s.
- Works, Ministry of.* Post War Building Studies No. 10. Solid fuel installations, by a committee convened by the British Coal Utilisation Research Association. 48 pp. 9d. No. 11. Electrical installations, by a committee convened by the Institution of Electrical Engineers. 95 pp. 1s. 6d. No. 12. The lighting of buildings, by the Lighting Committee of the Building Research Board of the Department of Scientific and Industrial Research. 164 pp. 2s. 6d. No. 14. Sound insulation and acoustics, by the Acoustics Committee of the Building Research Board of the Department of Scientific and Industrial Research. 80 pp. 1s. No. 16. Business buildings, by a committee convened by the Royal Institute of British Architects. 88 pp. 1s. London: H.M.S.O., 1944. $9\frac{1}{2}'' \times 6''$. 5 vols.

(b) British Empire.

Australia.

- Commonwealth Bureau of Census and Statistics.* Census of the Commonwealth of Australia, 30th June, 1933. Australian joint life tables, 1932–1934. Canberra: 1939. 93 pp. Statistician's report. Melbourne: 1940. xvi + 460 pp. $13'' \times 8\frac{1}{2}''$.

Eire.

- Department of Industry and Commerce.* Ireland. Register of population, 1941, classification of the population by areas, ages and conjugal conditions. Dublin: Stationery Office, 1944. $9\frac{1}{2}'' \times 6\frac{1}{2}''$. xxiv + 78 pp. 2s. 6d.

(b) British Empire—Contd.

India.

Office of the Economic Advisor. Guide to current official statistics, Vol. 1. Production and prices. (2nd ed.) Prepared under instructions from the Economic Advisor by *S. Subramanian*. Delhi: 1943. 9½" × 6¼". 137 pp. 6s. 6d.

Southern Rhodesia.

Department of Statistics. Second report on the census of industrial production, 1938-1942. Salisbury: 1944. 13" × 8". 22 pp.

(c) Foreign Countries.

Argentina—

Dirección General de Estadística y Censos de la Nación. Estadística industrial de 1941: resultados del relevamiento practicado al 31 de diciembre de 1941. Buenos Aires: 1944. 10¾" × 8¾". xiv + 330 pp.

Egypt—

Ministry of Finance, Statistical Department.

Annuaire statistique. 33, 1940-1941. 34, 1941-1942. Cairo: 1942-44. 12½" 9½". 2 vols.

Annual statement of foreign trade. 1940, 1941, 1942. Cairo: 1941-43. 12½" 8¼". 3 vols.

Industrial and commercial census, 1937. Cairo: 1942. 12½" × 9½". lxii + 811 pp.

Vital statistics, 1940, 1941. Cairo: 1942-43. 13" × 8½". 2 vols.

Mozambique—

Repertição Técnica de Estatística.

Censo da população em 1940. III. População indígena—população por sexos e grupos de idades, segundo o grau de instrução e a sua distribuição por naturalidades. Lourenço Marques: 1944. 10¼" × 7½". vi + 135 pp.

Recenseamento agrícola de 1939-1940. Contribuição para o segundo recenseamento agrícola mundial. Lourenço Marques: 1944. 10¼" × 7¼". iv + 1 + 143 pp.

Portugal—

Instituto Nacional de Estatística.

Estatística da educação. Ano lectivo de 1940-1941. Lisboa: 1944. 10½" × 7½". xvii + 608 pp.

VIII Recenseamento geral de população no continente e ilhas adjacentes em 12 de dezembro de 1940. Vol. VI, Distrito de Castelo Branco, 244 pp. Vol. VII, Distrito de Coimbra, 316 pp. Vol. VIII, Distrito de Évora, 260 pp. Vol. IX, Distrito de Faro, 294 pp. Vol. X, Distrito da Guarda, 272 pp. Vol. XI, Distrito de Leiria, 308 pp. Vol. XIII, Distrito de Portalegre, 272 pp.

Lisboa 1944. 12" × 9½". 5 vols.

Spain—

Dirección General de Estadística. Anuario estadístico de España. Ano XX, 1943. Madrid, 1944. 10½" × 7¼". xxxi + 1471 pp.

United States of America—

Agriculture, Department of. Index to publications of the United States Department of Agriculture, 1936-40. Edited by *Mary A. Bradley*. Washington: Government Printing Office, 1943. 9" × 6". v + 763 pp. \$1.50.

Census, Bureau of the.

Biennial census of manufactures, 1933, xi + 663 pp. 1935, xiii + 1279 pp. 1937, Part I, xvi + 1673 pp. Part II, vii + 135 pp. Washington: 1936-39. 9" × 6". 4 vols.

Cotton production and distribution. Bulletin 178, Season of 1940-41—Bulletin 180, Season of 1942-43. Washington: 1941-43. 9" × 6". 3 vols.

(c) Foreign Countries—Contd.

United States of America - Contd.

Census, Bureau of the—Contd.

- Cotton production in the United States. Crop of 1941 and 1942. Washington: 1943. 9" x 6". 37 pp.
- Financial statistics of cities, 1937-1939. Washington: 1940-43. 9" x 6". 3 vols.
- Financial statistics of cities, Vol. 3. Statistical compendium, 1940-1941. Washington: 1942-43. 11½" x 9". 2 vols.
- Financial statistics of states, 1937-1939. Washington: 1940-43. 9" x 6". 3 vols.
- Financial statistics of states, Vol. 3. Statistical compendium, 1940-1942. Washington: 1941-43. 11½" x 9". 3 vols.
- Sixteenth census of the United States: 1940. Manufactures, 1939. Vol. I. Statistics by subjects. viii + 438 pp. Vol. II, Part I. Reports by industries, groups 1-10. ix + 936 pp. Vol. II, Part II. Reports by industries, groups 11-20. viii + 708 pp. Vol. III. Reports for states and outlying areas. xi + 1192 pp. Washington: 1942. 11½" x 9". 4 vols.
- Statistical abstract of the United States. 1941. (63.) xxix + 1017 pp. 1942. (64.) xxv + 1097 pp. Washington: 1942-43. 9½" x 6".
- Vital statistics of the United States. 1937, Parts I and II—1941, Parts I and II. Supplement, 1939-1940, Part III. Washington: 1939-43. 11½" x 9". 11 vols.
- Federal Reserve System.* Banking and monetary statistics. Washington: Federal Reserve System, 1943. 10" x 8". xvi + 979 pp.
- Internal Revenue, Bureau of.* Bulletin F (Revised January 1942.) Income tax depreciation and obsolescence: estimated useful lives and depreciation rates. Washington: 1942. 9" x 6". vi + 93 pp.
- National Resources Planning Board.* Estimates of future population of the United States, 1940-2000. Prepared by Warren S. Thompson and P. K. Whelpton, of the Scripps Foundation for Research in Population Problems, for the Committee on Population Problems of the National Resources Planning Board. Washington: Govt. Printing Office, 1943. 11½" x 9". 137 pp. 35 c. (Presented by Dr. Bradford Hill.)

(d) International

International Labour Office.

- Studies and Reports. B.37. The T.V.A. lessons for international application, by Herman Finer. Montreal, 1944 (London: P. S. King). 9" x 6". viii + 289 pp. 6s.
- B.38. Social policy in dependent territories. Montreal: 1944 (London: P. S. King). 9" x 6". vi + 185 pp. 4s.
- B.39. The common interest in international economic organisation, by J. Condiffe and A. Stevenson. Montreal: (London: P. S. King.) 9" x 6". v + 135 pp. 4s.
- F.9. The safe installation and use of abrasive wheels. (2nd ed.) Montreal: 1944. 9" x 6". iv + 175 pp. 4s.

League of Nations—

- Economic, Financial and Transit Department.* International currency experience: lessons of the inter-war period. (II. A. 4.) Princeton: 1944 (London: Allen & Unwin). 9" x 6". 249 pp. 12s. 6d.

II.—AUTHORS AND MISCELLANEOUS

- Association of Drop Forgers and Stampers. Recommendations for uniform cost-estimating and cost finding for the drop forging industry. Birmingham: 1944. 8½" x 5½". 67 pp. + xii appendices.
- Basch (Antonin). The Danube basin and the German economic sphere. London: Kegan Paul, 1944. 8½" x 5½". xiv + 272 pp. 18s.
- Bell (Robert J. T.). An elementary treatise on co-ordinate geometry of three dimensions. London: Macmillan, 1944. xviii + 377 + xlvii pp. 15s.

II.—Authors and Miscellaneous—Contd.

- Bell Laboratories Record. Vol. 21, No. 5, Jan. 1943, to Vol. 23, No. 1, Jan. 1945. New York: 10" × 7". 25 parts.
- Bell Telephone System Technical Publications. Index of monographs. Vol. I. An index of Monographs B.481 to B.750 inclusive, and of Bell Telephone Laboratories Technical reprints B.1 to B.480 inclusive. 122 pp. Vol. II. An index of Monographs B.751 to B.1199 inclusive. 80 pp. Appendix to index of Monographs. B.1205 to B.1357. 7 pp. New York: 9" × 6".
- Bell Telephone System Technical Publications. B.277. Quality control, by *W. A. Shewhart*. 14 pp. 1927. B.327. Small samples—new experimental results, *W. A. Shewhart* and *F. W. Winters*. 10 pp. 1928. B.496. Economic quality control of manufactured product, by *W. A. Shewhart*. 26 pp. 1930. B.576. Random sampling, by *W. A. Shewhart*. 25 pp. 1931. B.1274. Single sampling and double sampling inspection tables, by *H. F. Dodge* and *H. Romig*. 61 pp. 1941. B.1345. Inspection in a manufacturing plant, by *D. B. Keeling* and *L. E. Cisne*. 14 pp. 1942. New York: 1927-42. 9" × 6". 6 parts.
- Beveridge (Sir William H.)*. Full employment in a free society: a report. London: Allen & Unwin, 1944. 8½" × 5½". 429 pp. 12s. 6d.
- Boag (Harold)*. The valuation of the outstanding liability for payments during incapacity in respect of workmen's compensation in the coal-mining industry. (From the *Journal of the Institute of Actuaries*, Vol. 72, 1942, pp. 8-34.) 8½" × 5½". (Presented by the Author.)
- Bristol Aeroplane Company, Ltd. (Aircraft Division). Quality control handbook: the machine shop. Bristol. 7½" × 4½". 46 + 1 pp. 3s. 6d.
- Bromwich (T. J. I'a)*. An introduction to the theory of infinite series . . . 2nd ed. revised with the assistance of *T. M. MacRobert*. London: Macmillan, 1942. 8½" × 5½". xv + 535 pp. 30s.
- Brown (William) and Thomson (Godfréy H.)*. The essentials of mental measurement. 4th ed. Cambridge: the University Press, 1940. 9½" × 6½". x + 256 pp. 22s. 6d.
- Cairncross (Alec)*. Introduction to economics. London: Butterworth, 1944. 7½" × 4½". vi + 430 pp. 12s. 6d.
- Cantril (Hadley)*. Gauging public opinion, by *Hadley Cantril* and research associates in the Office of Public Opinion Research, Princeton University. Princeton University Press. 1944. (London: Oxford University Press.) 9" × 6". xiv + 318 pp. 27s. 6d.
- Carslaw (H. S.)*. Introduction to the theory of Fourier's series and integrals. 3rd ed. London: Macmillan, 1930. 8½" × 5½". 368 pp. 20s.
- Central Electricity Board. Annual report. 13th, 1940, to 16th, 1943, inclusive. London: 1941-44. 10½" × 7½". 4 vols. (Presented by Mr. R. Y. Sanders.)
- Coats (R. H.)*. Cephalus: a prologue. (From *Trans. of Royal Society of Canada*, 3rd ser., Sect. II, 38, 1944.) Ottawa. 10" × 6½". 36 pp. (From the Author.)
- Cowles Commission for Research in Economics. Cowles Commission papers, New Series. 1. *Lange (Oscar)*. On the theory of the multiplier. 19 pp. 1943. 2. *Katona (George)*. The rôle of the frame of reference in war and post-war economy. 8 pp. 1944. 3. *Hurwicz (Leonid)*. Stochastic models of economic fluctuations. 11 pp. 1944. 4. *Haavelmo (Trygve)*. The probability approach in economics. viii + 118 pp. 1944. 5. *Marschak (Jacob)* and *Andrews (William H.)*. Random simultaneous equations and the theory of production. 63 pp. 1944. 6. *Cowles (Alfred)*. Stock-market forecasting. 6 pp. 1944. 7. *Katona (George)* and *Leavens (Dickson H.)*. Price increases and uptrading: the change in advertised prices of apparel and house furnishings. 13 pp. 1944. 8. *Lange (Oscar)*. The stability of economic equilibrium. 19 pp. 1944. Chicago: The University, 1943-44. 10" × 7". 8 parts.
- Czechoslovak Medical Association. United Nations issue, 1944, compendium of the Czechoslovak Medical Association in Great Britain, edited under the direction of the editorial committee in co-operation with Anglo-Czechoslovak Founders Committee of the International Allied Health Charter Movement. London: Czechoslovak Research Institute. 1944. 8½" × 5½". x + 102 pp. 5s.
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- Dudding (B. P.) and Jennett (W. J.)*. Quality control chart technique when manufacturing to a specification, with special reference to articles machined to dimensional tolerances. London: General Electric Co., 1944. 8½" × 5½". 74 pp. 2s. 6d.

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- A treatise on the integral calculus, with applications, examples, and problems. Vol. I, 1922. xxi + 907 pp. 50s. Vol. II, 1930. xv + 980 pp. 50s. London: Macmillan. 8½" × 5½".
- Feldman (W. M.). Biomathematics: being the principles of mathematics for students of biological science. . . . 2nd ed. London: Griffin, 1935. 7½" × 5". xviii + 480 pp. 28s.
- Finney (D. J.). The detection of linkage, V. Supplementary tables. (Reprint from *Annals of Eugenics*, Vol. 11, 1942, pp. 224-32.) The detection of Linkage, VII. Combination of data from matings of known and unknown phase. (Reprint from *Annals of Eugenics*, Vol. 12, 1943, pp. 31-43.) 10½" × 7½".
- Examples of the planning and interpretations of toxicity tests involving more than one factor. (Reprint from *Annals of Applied Biology*, Vol. 29, 1942, pp. 330-32.) 10" × 7".
- The statistical treatment of toxicological data relating to more than one dosage factor. (Reprint from *Annals of Applied Biology*, Vol. 30, 1943, pp. 71-79.) 10" × 7". (Presented by the Author.)
- Fisher (R. A.). The Design of experiments. 3rd ed. Edinburgh & London: Oliver & Boyd, 1942. 8½" × 5½". xi + 236 pp. 12s. 6d.
- Statistical methods for research workers. 9th ed. (Biological monographs and manuals, No. V.) Edinburgh & London: Oliver & Boyd, 1944. 8½" × 5½". xv + 350 pp. 16s.
- Fisher (R. A.) and Tippet (L. H. C.). Limiting forms of the frequency distribution of the largest or smallest member of a sample. (From *Proceedings of the Cambridge Philosophical Society*, Vol. 24, 1928, pp. 179-90.) 8½" × 5½". (Presented by Mr. Tippet.)
- Fowler (R. H.). Statistical mechanics: the theory of the properties of matter in equilibrium. 2nd ed. Cambridge University Press, 1936. 10" × 7". (8) + 864 pp. 52s. 6d.
- Fowler (R. H.) and Guggenheim (E. A.). Statistical thermodynamics: a version of statistical mechanics for students of physics and chemistry. Cambridge University Press, 1939. 10" × 7". x + 693 pp. 42s.
- Frankel (S. Herbert) and Hertzfeld (H.). An analysis of the growth of the national income in the Union in the period of prosperity before the war. (From the *South African Journal of Economics*. Vol. 12, 1944, pp. 112-38.) 9½" × 6½". (From the Authors.)
- Gallahue (Edward Eugene). Some factors in the development of market standards with special reference to food, drugs, and certain other household wares. Washington: Catholic University of America Press, 1942. 9" × 6". xiii + 209 pp.
- Gruenbaum (Ludwig). National income and outlay with reference to savings, capital movements, and investment. (Reprint from *South African Journal of Economics*, Vol. 12, 1944, pp. 28-45. 9½" × 6½". (Presented by the Author.)
- Hall (H. S.) and Knight (S. R.). Higher algebra: a sequel to *Elementary algebra for schools*. London: Macmillan, 1942. 7½" × 4¾". xxii + 557 pp.
- Harvard University Graduate School of Business Administration. Bureau of Business Research Bulletin. 119. Operating results of departments and specialty stores in 1943, by S. F. Teele. vi + 35 pp. 1944. \$2. 120. Expenses and profits of limited price variety stores in 1943: chains and independents. vi + 38 pp. 1944. \$1. 121. An analysis of operating data for small department stores. 1938-42, by E. A. Burnham. vi + 42 pp. \$1.50. Boston, Mass., 1944. 11" × 8½". 3 vols.
- Business Research Studies. 32. Teamwork and labor turnover in the aircraft industry of Southern California, by E. Mayo and G. F. F. Lombard. vii + 30 pp. \$1. 33. Excess profits tax relief: the cyclical provisions, by J. L. Snider. iv + 30 pp. 1944. \$1.50. 34. Future financial problems of conversion in the aircraft industry, by T. Lilley and L. L. Horton. iv + 49 pp. 1944. \$1.50. Boston: Mass., 1944. 11" × 7". 3 vols. (Presented by Mr. J. Menken.)
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II.—Authors and Miscellaneous *Contd.*

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- Jahnke (Eugene) and Emde (Fritz).* Tables of functions with formulae and curves (Funktionentafeln mit Formeln und Kurven). New York: Dover Publications, 1943. 9" × 6". 16 + 303 + 76 pp. (Presented by Mr. M. G. Kendall.)
- Jeffreys (Harold).* Scientific inference. Cambridge University Press, 1931. 8½" 5½". vii + 247 pp. (Presented by Mr. M. G. Kendall.)
- Kalecki (M.).* Studies in economic dynamics. London: Allen & Unwin, 1942. 7½" × 5". 92 pp. 6s.
- Kendall (M. G.).* On autoregressive time series. (From *Biometrika* 33, 1944, pp. 105–122.) 10" × 7". (From the Author.)
- Lange (Oscar).* Price flexibility and employment. (Cowles Commission for Research in Economics, Monograph No. 8.) Bloomington, Indiana: Principia Press, 1944. 9½" × 6¼". ix + 1 + 114 pp. \$2.
- Levy (Hermann).* National health insurance: a critical study. (National Institute of Economic and Social Research, Economic and social studies, IV.) Cambridge University Press, 1944. 8½" × 5½". x + 366 pp. 18s.
- MacMahon (Percy A.).* Combinatory analysis. Cambridge University Press, 1915–16. 10½" × 7½". 2 vols. 55s.
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- Mather (K.).* The measurement of linkage in heredity. London: Methuen, 1938. 6½" × 4½". ix + 132 pp. 5s.
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- Meade (J. E.) and Stone (Richard).* National income and expenditure. Oxford University Press, 1944. 7½" × 5". 36 pp. 2s.
- Military man power and American policy. Proceedings of a conference held at Princeton, New Jersey, September 25th, 1942, under the combined auspices of the Geopolitical Section of the Military Intelligence Service, The Institute for Advanced Study, and Princeton University. 10½" × 8½". 97 pp.
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- Oxford University, Institute of Statistics. The economics of full employment: six studies in applied economics prepared at the Oxford Institute of Statistics. Oxford: Blackwell, 1944. 8½" × 5½". vii + 213 pp. 12s. 6d.
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- Plaggio (H. T. H.).* An elementary treatise on differential equations and their applications. London: G. Bell, 1944. 8½" × 5½". xviii + 256 + xxvi pp. 12s. 6d.

II.—Authors and Miscellaneous—Contd.

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- Ross (J. F. S.)*. Parliamentary representation. London: Eyre & Spottiswoode, 1944. 8½" × 5½". 245 pp. 10s. 6d.
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- Sur (Atul K.)*. The index numbers—how to make them. (Reprinted from the *Financial Times*, Dec. 1942.) 10" × 6½". 2 pp.
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- Timoshenko (V. P.)*. World wheat production, its regional fluctuations and inter-regional correlations. (*Wheat Studies of the Food Research Institute*, vol. xviii, no. 7; vol. xix, no. 5; vol. xx, no. 6.) California: Stanford University, 1944. 11" × 8". [151] pp. \$3.
- Tippett (L. H. C.)*. On the extreme individuals and the range of samples taken from a normal population. (From *Biometrika*, 17, 1925, pp. 364–87.) 10" × 7".
- On the effect of sunshine on wheat yield at Rothamsted. (From *Journal of Agricultural Science*, 16, 1926, pp. 159–65.)
- Random sampling numbers (Tracts for Computers, xv). Cambridge University Press, 1927. 9" × 6½". viii + xxvi pp. 3s. 9d.
- Statistical methods in textile research. The analysis of complex variations. (*Shirley Institute Memoirs*, Vol. 8, 1929, pp. 175–96.) Part 2, Uses of the binomial and Poisson distributions, and Part 3, A snap-reading method of making time-studies of machines and operatives in factory surveys. (*Shirley Institute Memoirs*, Vol. 13, 1934, pp. 34–93.) Part 4, *Main (V. R.) and Tippett (L. H. C.)*. The design of weaving experiments (*Shirley Institute Memoirs*, Vol. 18, 1941, pp. 109–20.) Didsbury, Manchester, 1929–41, 3 parts.
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- Applications of statistical methods to the control of quality in industrial production. Manchester Statistical Society, 1936. 8½" × 5½". 32 pp.
- Statistical methods for textile technologists. Manchester: British Cotton Industry Research Association, 1937. 9½" × 6". 80 pp.
- Statistical aspects of the control of quality in textile manufacture. 60 pp. The statistical principles of experimentation with particular reference to experimentation in textile factories. 35 pp. Delivered at the Conference on Engineering and Industrial Statistics held at the Massachusetts Institute of Technology, Sept. 1938. Cambridge, Mass.: 9" × 6". 2 papers.
- The methods of statistics: an introduction mainly for experimentalists. 3rd ed. London: Williams & Norgate, 1941. 8½" × 5½". 284 pp. 17s. 6d.
- The place of statistics in general education and vocational training. Manchester Statistical Society, 1943. 8½" × 5½". 18 pp.
- Statistical methods in industry: a course of six lectures given in Sheffield by *L. H. C. Tippett*, with an introductory lecture by *Professor E. S. Pearson*, and a preface by *Sir William J. Larke*. London: British Iron and Steel Federation, Jan. 1943. 9½" × 6½". 74 pp.
- The control of industrial processes subject to trends in quality. (From *Biometrika*, 33, 1944, pp. 163–72.) 10½" × 7½". (Presented by Mr. L. H. C. Tippett.)
- Titchmarsh (E. C.)*. The theory of functions. 2nd ed. Oxford University Press, 1944. 8½" × 5½". x + 454 pp. 25s.
- Twin Cities Plan*. Post-war taxes: a realistic approach to the problem of federal taxation. St. Paul, Minnesota: Twin Cities Research Bureau, 1944. 11" × 8½". 27 pp.
- Turin (S. P.)*. The U.S.S.R.: an economic and social survey. London: Methuen, 1944. 8½" × 5½". xiii + 219 pp. 16s.
- Turner (Alice Willard)*. We all own Canada. Toronto: Collins, 1944. 7" × 4½". 63 pp. 25c.

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- Vakil (C. N.) and Patel (M. H.)*. Finance under provincial autonomy. Calcutta, London, etc.: Longmans, Green, 1940. 8½" × 5½". xi + 200 pp. 7s. 6d.
- Wechsler (David)*. The range of human capacities. London: Baillière, Tindall & Cox, 1935. 9" × 6". ix + 159 pp.
- Whittaker (E. T.) and Watson (G. N.)*. A course of modern analysis: an introduction to the general theory of infinite processes and of analytic functions; with an account of the principal transcendental functions. 4th ed. Cambridge University Press, 1940. 10" × 7". 608 pp. 42s.
- Widder (David Vernon)*. The Laplace transform. (Princeton Mathematical Series.) Princeton University Press. (London: Humphrey Milford.) 1941. 9" × 6". x + 406 pp.
- Wiener (Norbert)*. The Fourier integral and certain of its applications. Cambridge University Press, 1933. 8½" × 5½". xi + 201 pp. 15s.
- Wisden & Co. (John)*. John Wisden's cricketers' almanack . . . 1937 (74th ed.), 1938 (75th ed.), 1939 (76th ed.). London: John Wisden: 1937-39. (Presented by Sir William Elderton.)
- Yates (F.)*. Methods and purposes of agricultural surveys. (Reprint from a paper read before the Royal Society of Arts, Mar. 24, 1944.) 9½" × 6½". 10 pp. (Presented by the Author.)

PERIODICALS RECEIVED BY THE LIBRARY

ANNUAL LIST

In addition to the publications named in the bi-monthly lists, the Society has received during the past year the official and other periodicals enumerated below.

(a) United Kingdom and its several Divisions

National

United Kingdom—

- Admiralty.* Navy appropriation account.
Agriculture and Fisheries, Ministry of. Agriculture: journal of the Ministry of Agriculture.
Air Ministry. Air services appropriation account.
General Register Office. Registrar-General's statistical review of England and Wales. Registrar-General's weekly return of births and deaths. Quarterly return of births, deaths and marriages.
Health, Ministry of. National Health Insurance Fund accounts. Summary report of the Ministry of Health.
Home Office. Aliens (naturalization) return. Report of the Commissioner of Police of the Metropolis. State management districts (Licensing Act 1921) report.
Imperial Agricultural Bureau. Annual report of the Executive Council.
Industrial Health Research Board. Report.
Labour and National Service, Ministry of. Annual report of the Chief Inspector of Factories. Ministry of Labour gazette.
 — & *Ministry of Production.* Production and engineering bulletin.
Medical Research Council. Bulletin of war medicine.
Parliament. Parliamentary debates; House of Commons; House of Lords. The public general acts and the Church Assembly measures.
Stationery Office. Government publications, consolidated list.
Trade, Board of. Board of Trade journal.
Treasury. Account of the public income and expenditure. An analysis of the sources of war finance and estimates of national income and expenditure. Civil appropriation accounts. Civil estimates. Finance accounts. Financial statement. Revenue departments appropriation accounts. Trading accounts and balance sheets. Votes of credit.
War Office. Army appropriation account.

Municipal and other local returns

IPSWICH: Abstract of the audited accounts. LIVERPOOL: Report on the health of the City. MANCHESTER: Abridged report on the health of the City.

Scotland—

- Agriculture, Department of.* Scottish journal of agriculture.
Health, Department of. Summary report.
Registrar-General. Annual report of the Registrar-General. Births, deaths and marriages [weekly and quarterly returns].
 GLASGOW. Report of the Medical Officer of Health.

Northern Ireland—

- General Register Office.* Quarterly return of births, deaths and marriages. Registrar-General's annual report.

(a) United Kingdom and its several Divisions *Contd.**Miscellaneous Publications*

- Accountant. Accountants' magazine. Agenda. Alliance news. Anglo-Swedish review. Annals of eugenics. Auctioneers' and Estate Agents' Institute, Journal. Banker. Bankers' almanac and year-book. Bankers' Clearing House, annual statement. Bankers' magazine. Bank of England, Statistical summary. Belfast, Queen's University calendar. Biometrika. Bradford Chamber of Commerce: Statistics relating to the worsted, woollen and artificial silk trades. British Association for the Advancement of Science, The advancement of science. Building industries survey. Building societies year-book.
- Cambridge University abstract of dissertations. Chamber of Commerce journal. Chamber of Shipping of the U.K., annual report. Chartered Surveyors' Institution, Journal. Colliery guardian. Co-operative Union Ltd.: Co-operative review. Report of the annual co-operative congress. Corporation of Foreign Bondholders, annual report. Czechoslovak Medical Association in Great Britain, Bulletin.
- Central Electricity Board annual report.
- Dalgety's annual wool review.
- Economic journal. Economica. Economist. Economista Polski. Eugenics review.
- Fabian Society: Fabian news, Fabian quarterly, Research series, Faculty of Actuaries: Transactions, Year-book. Fireman.
- Fehr & Co. (Frank). Review of the oilseed, oil and oil cake markets.
- Geographical journal.
- Incorporated Association of Rating and Valuation Officers, Journal. Institute of Actuaries: Journal, Year-book. Institute of Bankers, Journal. Institute of Industrial Administration, Journal. Insurance directory and year-book. International Federation of Trade Unions, Bulletin. International Tin Research and Development Council, Statistical year-book. Iron and Steel Institute, Journal.
- King Edward's Hospital Fund: Annual report, Statistical summary.
- Land and liberty. London and Cambridge Economic Service: Bulletin.
- Mallett and Co., Weekly wool chart. Manchester Statistical Society, Transactions. Municipal year-book.
- National Association for Prevention of Tuberculosis: Report of Council. National Institute of Economic and Social Research: Annual report, Diary. Nature.
- Oxford Institute of Statistics: Annual report, Bulletin, Oxford economic papers.
- Peabody Donation Fund, Annual report of Governors. Planning. Post magazine.
- Powers-Samas magazine. Public administration.
- Quarterly journal of mathematics.
- Rates levied on various towns. Registered accountant. Review of economic studies. Royal Agricultural Society of England: Journal, Quarterly review. Royal College of Surgeons of England, Calendar. Royal Institute of International Affairs, Annual report of the Council. Royal Institution, Proceedings. Royal Meteorological Society, Journal. Royal Sanitary Institute, Journal. Royal Society of Arts, Journal. Royal Society of Edinburgh: Proceedings, Transactions.
- Samuel Montagu and Co.: Annual bullion review. Secretary. Seyd (R.E.), statistics of failures. Signal. Society of Incorporated Accountants and Auditors, Year book. Sociological review. Statesman's year book. Statist.
- Tabulator. Taitersall's cotton trade review (Dec. issue). Taxation. Times.
- Times literary supplement. Times trade and engineering supplement. Tin.
- United empire.
- Whitaker's almanack. Who's who. Willing's press guide.

(b) British Empire

Australia—

- Bureau of Census and Statistics. Demography. Finance. Labour report. Monthly review of business statistics. Official year book. Press notices. Production. Quarterly summary of Australian statistics. Transport and communication.
- Commonwealth Grants Commission. Report.
- Commonwealth Bank of Australia. Statistical bulletin.
- Economic record.

(b) British Empire—Contd.

NEW SOUTH WALES—

- Bureau of Statistics and Economics.* Official year book of New South Wales.
Statistical bulletin. Statistical register.
Department of Railways. Report of the Commissioner for Railways.
Parliament. Budget papers. Report of the Auditor-General.

SOUTH AUSTRALIA—

- Statistical Office.* Statesman's pocket year-book. Statistical register.

TASMANIA—

- Bureau of Census and Statistics, Tasmania Branch.* Pocket year book of Tasmania.
Statistics of the State of Tasmania.
State Finance Committee. The Tasmanian economy.

VICTORIA—

- Office of the Government Statist.* Victorian year-book. Annual report on friendly societies.

WESTERN AUSTRALIA—

- Government Statistician's Department.* Pocket year-book. Quarterly statistical abstract. Statistical register.
Registrar of Friendly Societies. Report of proceedings.

Canada—

- Bank of Canada.* Statistical summary.
Department of Agriculture. Report of the Veterinary Director-General.
Department of Finance. Public accounts.
Department of Justice. Annual report of the Superintendent of Penitentiaries.
Department of Labour. Labour gazette. Report.
Dominion Bureau of Statistics.
Fisheries and Animal Products Branch. Fisheries statistics. Statistics of dairy factories.
General Manufactures Branch. Food products, beverages, rubber and miscellaneous manufactures based on vegetable products. Manufacturing industries of Canada, summary report.
General Statistics Branch. Canada year book. Monthly review of business statistics.
Mining, Metallurgical and Chemical Branch. Annual report on the mineral production of Canada. Chemicals and allied products in Canada. Coal statistics for Canada. Iron and steel and their products in Canada. Manufactures of non-metallic minerals in Canada.
Vital Statistics Branch. Vital statistics.

ALBERTA. *Department of Public Health.* Annual report of the Vital Statistics Branch.

ONTARIO (PROVINCE). *Department of Agriculture.* Annual report of the Statistics Branch. Monthly crop report. Monthly dairy report. Report of the Minister of Agriculture.

QUEBEC (PROVINCE). Bulletin météorologique. Statistical year-book.

Bank of Nova Scotia, Monthly review.

Canadian Bank of Commerce, Monthly commercial letter.

Royal Bank of Canada. Monthly letters.

Ceylon—

Administrative reports. Ceylon sessional papers. Minutes of the State Council.

Eire—

Central Bank of Ireland. Quarterly statistical bulletin.

Department of Industry and Commerce. Irish trade journal and statistical bulletin. Statistical abstract.

(b) British Empire—Contd.

Éire—Contd.

Department of Local Government and Public Health. Annual report of the Registrar-General. Quarterly return of the marriages, births and deaths.
Irish Agricultural Organization Society Ltd. Report.
Statistical and Social Inquiry Society of Ireland, Journal.

India—

Department of Commercial Intelligence and Statistics. Accounts relating to sea-borne trade and navigation. Monthly statistics of cotton spinning and weaving. Monthly statistics of the production of certain selected industries. Statistical abstract for British India.
Reserve Bank of India. Statistical tables relating to banks in India and Burma.
Statistical Research Branch. Review of the trade of India.
 BOMBAY. Labour gazette.
 PUNJAB. Memoirs of the Irrigation Research Institute.
Indian journal of economics.
Sankhya, Indian journal of statistics.

New Zealand—

Census and Statistics Department. Agricultural and pastoral production. Factory and building production. Local authorities' handbook. Monthly abstract of statistics. New Zealand official year-book. Pocket compendium of New Zealand statistics. Population and buildings. Report on the insurance statistics. Report on the Justice statistics. Statistical report on prices, wages . . . banking, building societies, commercial afforestation, incomes and income tax. Trade and shipping. Vital statistics.
National Provident Fund. Annual report of the Board.
 Auckland Chamber of Commerce. The Commerce journal.
 Canterbury Chamber of Commerce, Bulletin.
 Royal Society of New Zealand, Transactions and proceedings.

Palestine—

Department of Migration. Statistics of migration and naturalization.
Office of Statistics. General monthly bulletin of current statistics. Statistical abstract of Palestine.

Southern Rhodesia—

Department of Statistics. Economic and statistical bulletin.
 Chamber of Mines of Rhodesia: Annual report. Report of Executive Committee (monthly).

Union of South Africa—

Department of Customs and Excise. Annual statement of the trade and shipping.
Office of Census and Statistics. Monthly bulletin of statistics.
 CAPE OF GOOD HOPE. Ordinances.
South African journal of economics.

(c) Foreign Countries

Argentine Republic—

Dirección General de Estadística. Anuario del comercio exterior. El comercio exterior Argentino. Estadística industrial. Informe: El comercio exterior Argentino, Estadística industrial, La población y el movimiento demográfico. BUENOS AIRES (PROVINCIA DE). Anuario estadístico.
 Banco de la Nación Argentina, Memoria y balance general, Rivista. Camoati.

(c) Foreign Countries—Contd.

Brazil—

Conselho Federal de Comercio Exterior. Boletim.

Chile—

Dirección General de Estadística. Estadística Chilena.

Egypt—

Département de la Statistique Générale. Annual statement of foreign trade.

Annuaire statistique. Vital statistics.

L'Egypte contemporaine.

France—

Journal de la Société de Statistique de Paris.

Iceland—

Bureau de Statistique. Statistique de l'Islande [including annual reports on agriculture, fisheries, trade, etc.].

National Bank of Iceland and Statistical Bureau of Iceland. Statistical bulletin.

Mexico—

Dirección General de Estadística. Revista de estadística.

Estadística, journal of the Inter-American Statistical Institute.

Mozambique—

Repartição Técnica de Estatística. Anuário estatístico. Boletim trimestriel de estatística. Estatística do comércio externo da navegação.

Peru—

Departamento de Estadística General de Aduanas. Anuario del comercio exterior.

Boletín de la Superintendencia General de Aduanas.

Banco Central de Reserva, Boletín. Memoria.

Portugal—

Instituto Nacional de Estatística. Anuário demográfico. Anuário estatístico.

Anuário estatístico das contribuições e impostos. Anuario estatístico do imperio colonial.

Boletim mensal, comércio externo. Estatística da educação. Estatística da organização corporativa. Estatística judiciária. Situação bancária.

Spain—

Dirección General de Estadística. Anuario estadístico de España. Boletín de estadística.

Revista de estudios políticos.

Sweden—

Statistiska Centralbyrån. Statistisk årsbok. Statistiska meddelanden; Ser. A.

Ser. D (Järnvägsstatistiska meddelanden). Ser. E (Uppgifter om bankerna).

Sveriges officiella statistik.

Stockholms Stats Statistiska Kontor. Statistisk årsbog.

Ekonomisk tidskrift.

Ingeniörsvetenskapsakademien Handlingar.

Switzerland—

Bureau Fédéral des Assurances. Les entreprises d'assurances privées en Suisse.

BASEL. *Statistisches Amt.* Statistisches Jahrbuch des Kantons Basel-Stadt.

ZÜRICH. Statistisches Jahrbuch der Stadt Zürich. Zürcher statistische Nachrichten.

Union suisse du Commerce et de l'Industrie, Rapport sur le commerce et l'industrie de la Suisse.

Turkey—

Office Central de Statistique. Annuaire statistique.

(c) Foreign Countries—Contd.

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